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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 48 JULY 1948 NUMBER 1

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HERPES ZOSTER OTICUS ("RAMSAY HUNT SYNDROME")

Report of a Case

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THE PURPOSE of this paper is to present a severe case of herpes zoster oticus with complete paralysis of the facial nerve, involvement of both the vestibular and the cochlear branches of the eighth nerve and unusual findings in the cerebrospinal fluid. The patient was recently treated at the Massachusetts Memorial Hospitals. The relevant literature will be briefly reviewed.

Herpes zoster has been known since ancient times. It was called zona by the Greeks[1] and was considered a cutaneous disease for centuries. Bright[2] (1831) and Henley[2] (1840), cited by Ebstein, first pointed out that herpes zoster was a cutaneous manifestation of a nerve disease involving the sensory portion of the spinal nerves. The first reported autopsy on a case of herpes zoster was that of von Barensprung,[2] in 1861, who demonstrated inflammatory lesions at the posterior root ganglions. That the disease could involve cranial nerves was demonstrated by many observers, but Tryde[3] in 1872 was the first to report a case of herpes zoster with facial paralysis.

The syndrome of herpes zoster of the ear with facial paralysis and acoustic symptoms was intensively studied and elaborated by Ramsey Hunt in 1907.[4]

1. Cecil, R. L.: A Text-Book of Medicine, ed. 3, Philadelphia, W. B. Saunders Company, 1933, p. 1496.

2. Ebstein, W.: Zur Lehre von den nervösen Störungen beim Herpes zoster mit besonderer Berücksichtigung der dabei auftretenden Facialislähmungen, Virchows Arch. f. path. Anat. **139**:505, 1895; cited by Tschiassny.[7b]

3. Tryde, C.: Bemerkungen zur Facialisparese, Schmidt's Jahrb. **2**:272, 1872; cited by Tschiassny.[7b]

4. Hunt, J. R.: On Herpetic Inflammations of the Geniculate Ganglion: A New Syndrome and Its Complications, J. Nerv. & Ment. Dis. **34**:73, 1907.

He stated: "Heretofore, the only recognized seat of an herpetic inflammation on a cranial nerve was that of the gasserian ganglion of the trifacial. Herpes zoster in the distribution of one or more of its branches was the result. I believe, however, that the geniculate ganglion situated in the depths of the internal auditory canal and the entrance to the Fallopian aqueduct may be the seat of this specific inflammation."

Hunt analyzed the sensory innervation of the ear and described the "zoster zone" for the geniculate ganglion as comprising, roughly, a portion of the drum, the external auditory canal, the tragus, antitragus, concha, a part of the helix and a strip of the lobule. Here the typical herpetic lesions of geniculate zoster are to be found. The geniculate zone of the auricle is bounded anteriorly by the gasserian zone and posteriorly by the cervical zone, with some overlapping. Hunt classified herpes zoster at the cephalic extremity according to the sensory ganglion involved and the site of the rash into the following groups:

(1) Geniculate herpes zoster (herpes oticus)
(2) Gasserian herpes zoster (herpes facialis)
(3) Cervical herpes (herpes occipito-collaris)

The geniculate zoster syndrome was further classified by Hunt according to the severity of the symptoms and the degree of extension into four main groups:

(1) Simple herpes zoster auricularis without neurologic signs.
(2) Herpes zoster oticus with facial palsy.
(3) Herpes zoster oticus with facial palsy and mild acoustic symptoms (diminishing hearing and tinnitus).
(4) Herpes zoster oticus with facial palsy and Ménière's symptom complex (deafness, tinnitus, vertigo, nystagmus, nausea, and vomiting).

Hunt stressed that the major site of the pathologic lesion in herpes zoster oticus was the geniculate ganglion of the facial nerve. Increased pressure of the swollen ganglion on the facial nerve resulted in facial palsy; the simultaneous infection of the adjacent ganglions of the eighth nerve or the extension of the inflammatory process from the facial to the auditory nerve by means of their communicating nerve filament accounted for the symptoms of deafness, tinnitus, vertigo, nystagmus, nausea and vomiting.

The present day conception of herpes zoster has been briefly summarized by Denny-Brown, Adams and Fitzgerald[5] as follows:

The disease is probably due to a filtrable virus, similar to, if not identical with, that of varicella, which provokes acute inflammatory reaction in isolated spinal or cranial sensory ganglia, the posterior gray matter of the spinal cord and the adjacent leptomeninges. The clinical manifestations are a vesicular cutaneous eruption, radicular neuralgia, and less often segmental palsies and sensory loss.

5. Denny-Brown, D.; Adams, R. D., and Fitzgerald, P.: Pathologic Features of Herpes Zoster: A Note on "Geniculate Herpes," Arch. Neurol. & Psychiat. **51**:-216 (March) 1944.

In his recent excellent review of the extensive literature on herpes zoster, Baird[6] stated that "during the thirty-five years since Hunt crystallized medical thought" concerning the geniculate zoster syndrome "few cases have been reported, and little has been added to Hunt's original concept of the disease." More recently, however, Hunt's concept of the geniculate ganglion as the site of the herpetic inflammation in herpes zoster of the ear with facial palsy has been seriously challenged.

Denny-Brown[5] and his co-workers studied histopathologically a case of auricular and occipital herpes with facial palsy. They found a typical necrotizing ganglionitis of the second cervical ganglion, and a patchy motor neuritis of the facial nerve, but no changes at all in the geniculate ganglion. They concluded that "the evidence for geniculate ganglionitis in the Ramsay Hunt syndrome is invalid."

Tschiassny[7b] reexamined the problem from the clinical point of view in connection with 2 cases of herpes zoster of the cephalic extremity associated with facial palsy by recalling the anatomy of the afferent and efferent portions of the facial nerve and their branches of distribution. He stressed several topognostic signs which aid in the clinical localization of lesions of the facial nerve, namely, the presence of taste at the anterior two thirds of the tongue and the presence of lacrimation on the affected side.

It will be recalled that the facial nerve enters the internal auditory meatus with the auditory nerve and here gives off a small communicating branch to the eighth nerve. All other branches of the facial nerve are given off at or distal to the geniculate ganglion, the main trunk of the nerve leaving the temporal bone at the stylomastoid foramen to supply the muscles of expression, the stylohyoid and posterior belly of the digastric muscles. Paralysis of the muscles of expression includes, of course, the orbicularis oculi muscle, the lacrimal portion of which, known as Horner's muscle, opens the lacrimal sac. Paralysis of this muscle prevents the tears, when present, from entering the lacrimal sac and the tears flow over onto the cheek (epiphora).

An important branch of the facial nerve, the greater superficial petrosal, leaves the facial nerve at the geniculate ganglion, carrying parasympathetic secretory fibers, and enters the sphenopalatine ganglion. Postganglionic fibers leaving the ganglion pass by anastomosing fibers to the lacrimal branch of the ophthalmic division of the fifth nerve to supply secretory fibers to the lacrimal gland. A lesion of the geniculate

6. Baird, P. E.: Herpes Zoster, New England J. Med. **228**:568, 1943.

7. (*a*) Denny-Brown and others.[5] (*b*) Tschiassny, K.: The Site of the Facial Nerve Lesion in Cases of Ramsay Hunt's Syndrome, Ann. Otol., Rhin. & Laryng. **55**:152, 1946. (*c*) O'Neill, H.: Herpes Zoster Auris ("Geniculate" Ganglionitis), Arch. Otolaryng. **42**:309 (Nov.-Dec.) 1945.

ganglion will therefore destroy these secretory fibers and diminished or absent lacrimation will result.

Taste sensation from the anterior two thirds of the tongue is carried by way of the chorda tympani nerve to the geniculate ganglion. The taste fibers, contrary to the accepted concept, do not course from the ganglion centrally by way of the facial nerve; but rather, as suggested by Tschiassny, by way of the petrosal nerves from the geniculate ganglion to the tympanic plexus, to Jacobson's nerve and thence to the brain stem via the glossopharyngeal nerve. This is substantiated by the writings of Cushing,[8] Piersol,[9] and others. Ballenger[10] states that "lesions central to the geniculate ganglion do not affect the sense of taste."

It is apparent, therefore, that the presence or absence of taste in the anterior two thirds of the tongue in a case of facial paralysis is of great topognostic significance, taste being lost in lesions which affect the geniculate ganglion or that portion of the facial nerve (in the fallopian canal) from the ganglion to the point of exit of the chorda tympani nerve. Lesions below the chorda tympani nerve (infrachordal lesions) and lesions above the geniculate ganglion (suprageniculate) will not result in loss of taste. Thus one may divide the facial nerve in its peripheral course into four parts.

(1) Supragenicular. Lesions here will not result in loss of taste but, by involving the fibers to the greater superficial petrosal nerve, will result in absence or diminution of tears ("dry eye").

(2) Transgeniculate. A lesion here will destroy the taste fibers as well as the secretory fibers to the lacrimal gland. Hence, the patient will have loss of taste in the anterior two thirds of the tongue and a "dry eye."

(3) Suprachordal (above the point of exit of the chorda tympani nerve but below the geniculate ganglion). A lesion of this region of the facial nerve will obviously disrupt the taste fibers but will not affect the secretory fibers to the lacrimal gland. Tears will be present but taste will be absent.

(4) Infrachordal. Disease or injury of this, most peripheral, portion of the facial nerve will obviously miss the taste fibers, and taste sensation to the anterior two thirds of the tongue will remain intact. The facial muscles of expression will, of course, be paralyzed and as a result of par-

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8. Cushing, H.: The Taste Fibers and Their Independence of the Nervus Trigeminus, Bull. Johns Hopkins Hosp. **14**:71, 1903.

9. Piersol, G. A.: Human Anatomy, revised by G. C. Kiever, ed. 9, Philadelphia, J. B. Lippincott Company, 1930, p. 1247.

10. Ballenger, W. L., and Ballenger, H. C.: Diseases of the Nose, Throat and Ear: Medical and Surgical, ed. 7, Philadelphia, Lea & Febiger, 1938, p. 785.

alysis of Horner's muscle there may be present an annoying overflow of the normally secreted tears onto the cheek (epiphora).

The foregoing topognostic signs are well summarized by Tschiassny in the table:

Topognostic Signs as Summarized by Tschiassny

Location of Lesion	Presence of Taste	Tears
Infrachordal	Yes	Yes
Suprachordal	No	Yes
Transgeniculate	No	No
Suprageniculate	Yes	No

Tschiassny concludes that: "It becomes evident that the regional diagnosis of peripheral facial nerve lesions is essentially based on the joint consideration of two factors: taste and lacrimation."

Reviewing 22 cases of herpes zoster with facial paralysis (Hunt's syndrome) in the literature, with regard to the topognostic signs recorded in the table, Tschiassny found that in only 7 of them could the lesion be placed in the geniculate ganglion, in contrast to the tenets of Ramsey Hunt.

REPORT OF CASE

Our patient, a 67 year old white, single woman, was admitted to the Private Pavilion of the Massachusetts Memorial Hospitals on Dec. 24, 1946, with the chief complaints of dizziness, nausea and vomiting of about two weeks' duration.

The past history and family history were noncontributory. There was no history of venereal disease, tuberculosis, previous herpetic infection or recent exposure to chickenpox.

Present Illness.—On Dec. 6, 1946, for no apparent cause, the patient first noted a mild discomfort in and about her right ear, which on the following day felt swollen and somewhat tender. On December 9 she noted the onset of vertigo, nausea and vomiting, diminished hearing in the right ear and some soreness of the right side of the tongue and throat. She was seen by her physician on December 10, and he found: (1) right facial palsy not previously noted by the patient, (2) "stomatitis" involving the right side of the tongue and fauces, (3) an inflamed right ear canal and gray, thickened drum with exudate in the canal, and (4) a temperature of 101 F. A diagnosis of otitis externa and media with stomatitis was made, and the patient was given orally penicillin tablets (50,000 units every three hours) and 5 per cent sulfathiazole ointment was instilled into the ear canal. The fever and "stomatitis" promptly subsided, but the vertigo, vomiting and facial paralysis persisted for the next two weeks. The patient then also noted an annoying and persistent sense of dryness and irritation of the right eye. She was transferred to the Massachusetts Memorial Hospital, arriving on Christmas eve, 1946.

Physical Examination.—Examination revealed an elderly woman obviously suffering from marked vertigo, nausea and vomiting and showing evidence of moderate dehydration and slight loss of weight. The temperature was 98.6 F., the pulse rate 76 and respirations 24. There was a complete peripheral right facial paralysis with diminished to absent lacrimation in the right eye. The right conjunctiva was slightly injected. There was a mild horizontal and rotary nystagmus on far lateral gaze. The media and fundi were normal. The corneal reflex was present. The extraocular muscles were intact. The tongue was dry, but otherwise

normal with taste sensation intact. There were no lesions in the mouth, pharynx or larynx. Hearing was obviously defective on the right. On the posterior surface of the right ear canal near the concha there was a small hemorrhagic lesion, resembling a localized hematoma. The external canal contained a small amount of exudate resembling ointment, which also covered the tympanic membrane. This was cultured and then removed, revealing an intact drum and no evidence of otitis media. The left ear canal and drum were normal, and hearing for conversation was normal.

The remainder of the examination gave entirely normal results. A diagnosis of Ramsey Hunt syndrome was made on admission.

Laboratory and roentgen studies revealed: The blood leukocyte count on admission was 10,000 per cubic millimeter with 62 per cent polymorphonuclears; urinalysis gave negative results; reaction to the Hinton test of the blood was negative. The cerebrospinal fluid was crystal clear and under normal pressure with normal dynamics and a cell count of 450 per cubic millimeter, all lymphocytes; globulin was increased; the sugar content was 58 mg. per hundred cubic centimeters; the colloidal gold and Wassermann tests gave negative results and there was no growth on cultures. Roentgenograms of the skull, mastoids and chest on admission revealed no abnormalities. Bacteriologic study of the "exudate" of the right ear canal and drum revealed lipid material, no cellular elements, no organisms and no growth (sulfathiazole ointment).

Audiometric examination of hearing revealed a moderate nerve deafness in the left ear consistent with the patient's age, but good hearing for the speech frequencies (average 15 decibel loss); there was, however, a severe loss of hearing in the right ear with inability to hear any of the frequencies above 2048 double vibrations and with an average loss of 75 decibels for the conversational frequencies (marked nerve deafness).

Course.—The patient was given supportive care, fluids intravenously, nicotinic acid (100 mg. three times a day) and thiamine chloride (20 mg. orally three times a day and 50 mg. intravenously). Chemotherapeutic drugs were withheld. On December 27 several small vesicles were noted on the right concha, which was mildly erythematous but not painful or tender. Taste remained normal over the entire tongue. The patient was seen in consultation on this date by Dr. Chester S. Keefer, professor of medicine at Boston University School of Medicine. He corroborated the diagnosis of "geniculate herpes zoster," but pointed out that the marked cerebrospinal fluid pleocytosis was unusually high for herpes zoster.

The patient remained afebrile throughout her hospital stay. By Jan. 4, 1947 the vesicles of the auricle had disappeared, the vertigo and nausea had almost completely cleared, and there was slight improvement in the facial paralysis. On January 6 the patient was presented at the medical-surgical conference of the Massachusetts Memorial Hospitals—involving a trip by ambulance of several miles, without ill effect. Two days later, two weeks after admission and four weeks after onset, lacrimation returned to the right eye; the cerebrospinal fluid contained 200 cells per cubic millimeter, all lymphocytes, with a normal amount of sugar and globulin. The facial paralysis and deafness of the right ear remained unchanged.

Cold caloric labyrinthine tests (Kobrak method) on January 27 revealed no response to stimulation with 50 cc. of ice water in the right ear (normal response in the left), and audiograms showed severe loss of hearing in the right ("dead" labyrinth, right ear). On January 28, because of an annoying ectropion of the right lower lid resulting from the persisting facial paralysis, the everted right lower lid was partially sutured to the upper lid, resulting in marked improvement of the annoying irritation of that eye from the now normal lacrimation.

Lumbar puncture on January 30 revealed the cerebrospinal fluid to be again sterile, with normal pressure and dynamics, a normal amount of sugar and protein, and containing 30 cells per cubic millimeter, of which 53 per cent were lymphocytes, 33 per cent polymorphonuclear leukocytes, 7 per cent monocytes and 7 per cent erythrocytes.

The patient was discharged on February 4, asymptomatic except for unilateral profound deafness and persistent though slightly improved palsy of the right side of the face.

COMMENT

It is apparent that our case is unusual in several respects. The presence of zoster lesions on the auricle with facial paralysis and Ménière's symptom complex places this case in the rare group 4 of Hunt's classification of "geniculate zoster." However, the absence of lacrimation and the preservation of taste on the anterior two thirds of the tongue on the involved side suggest that the site of the facial nerve lesion, as already discussed, was supragenicular, probably in the internal auditory meatus in close proximity to the meninges. In all probability the ganglions involved primarily were those of the eighth nerve (vestibular and cochlear) and the disease involved the facial nerve either via the communicating branch from the seventh to the eighth nerve, above the geniculate ganglion, or via the adjacent inflammatory edema.

When it is recalled that the region of the auricle and external auditory canal is supplied by four cranial nerves (the fifth, seventh, ninth and tenth) and by the upper cervical nerves, and that the facial nerve anastomosis with these, it becomes apparent that paralysis of the facial nerve with herpetic lesions on or about the auricle may result from involvement by the zosterian inflammation of the ganglions of any of these nerves, and does not necessarily indicate involvement of the geniculate ganglion as claimed by Hunt. It is preferable to reserve the name "Hunt's syndrome" or "geniculate zoster" for those cases of herpes zoster oticus in which the lesion can be demonstrated in the geniculate ganglion either by histopathologic study or by topognostic analysis.

To us, the most interesting feature of this case was the high pleocytosis of the cerebrospinal fluid, indicating severe localized meningitis. That the spinal fluid is frequently involved in herpes zoster has been stressed by many observers,[1] Denny-Brown and his co-authors[5] believing that a localized leptomeningitis is always present in herpes zoster. Baird[6]

11. Madonick, M. J.: Meningoencephalitis Complicating Herpes Zoster Ophthalmicus After Treatment by Vaccination, Arch. Neurol. & Psychiat. **56**:434 (Oct.) 1946. Brown, W. H., and Dujardin, B.: The Cerebrospinal Fluid in Herpes Zoster, and the Relation of Herpes Zoster to Syphilis, Brain **42**:86, 1919. Touraine, A.: Zona et liquide céphalo-rachidien, Ann. de dermat. et syph. **6**:289, 1935. Wiegmann, F.: Herpes zoster cephalicus (20 eigene Beobachtungen), München. med. Wchnschr. **81**:1970, 1934. Gordon, I. R. S., and Tucker, J. F.: Lesions of the Central Nervous System in Herpes Zoster, J. Neurol., Neurosurg. & Psychiat. **8**:40, 1945.

stressed that the cerebrospinal fluid lymphocytosis is, in fact, of great aid in the diagnosis. Merritt and Fremont-Smith[12] report an increase in the cells of the spinal fluid in 6 of their 8 cases. However, we have been unable to find in the literature at our disposal a cerebrospinal fluid lymphocytosis as high as the one shown by our patient, 450 cells per cubic millimeter, the pleocytosis in most reported cases being well under 100 cells.

It appears likely that an abnormal cerebrospinal fluid will be found more frequently when lumbar punctures are routinely performed in cases of herpes zoster.

It seems reasonable, too, that in many cases herpes zoster is misdiagnosed as otitis media or externa, eczema, Bell's palsy, etc. It is noteworthy that the only two physicians who have recorded their subjective experience with herpes zoster oticus, Anstie[13] in 1871 and Rosenberger[14] in 1941, ascribed their symptoms at first to otitis following exposure to cold.

SUMMARY

A brief review of the literature of herpes zoster oticus ("Ramsay Hunt syndrome") is presented.

An unusual case of herpes zoster oticus with facial paralysis, Ménière's symptom complex and marked cerebrospinal fluid lymphocytosis is recorded.

It is emphasized that the terms "Hunt syndrome" or "geniculate zoster" should be restricted to cases showing definite involvement of the geniculate ganglion as evidenced by histopathologic study of topognostic analysis.

The value of lumbar puncture in cases of herpes zoster is stressed.

20 Bay State Road.

12. Merritt, H. H., and Fremont-Smith, F.: The Cerebrospinal Fluid, Philadelphia, W. B. Saunders Company, 1938, p. 137.

13. Anstie, F. E.: On Auricular Herpes Zoster and Its Treatment, Practitioner, London **7**:198, 1871.

14. Rosenberger, H. C.: Herpes Zoster Oticus with Facial Paralysis and Acoustic Symptoms: Subjective Experience, Ann. Otol., Rhin. & Laryng. **50**:271, 1941.

CLEFT LIP AND PALATE

Some Technical Procedures Used in Its Treatment, with Especial Reference to Closure of Complete Cleft of the Anterior Half of the Palate

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ROCHESTER, MINN.

IN CONSIDERING the surgical treatment of harelip, Blair[1] once said:

". . . If he learns to use any one of the standard methods the surgeon who essays the correction of nose and lip defects will expend his energy to greater profit than if he attempts to exercise eclecticism or, more dangerous yet, to contrive new methods. It is true that operative skill rather than breadth of acquaintance will bring greater satisfaction to the patient thus afflicted. This statement is made wih no intention of belittling invention or ingenuity but rather to urge that these qualifications be directed, in the case in hand, toward adapting some well tried out plan.

Several interesting comments were made by the discussers of a recent paper by Vaughan.[2] One said, "There is no single procedure which will correct every lip (and . . . nostril) satisfactorily." Another said, "Each makes his own modifications even if he doesn't realize it." Still another said, "The method . . . should be adapted to the individual situation."

To these comments I should like to add that in the correction of harelip and its associated nasal deformities the best results will be obtained by the surgeon who is able to analyze the problems of the case in hand and to choose the best well tried plan and, finally, who has the operative skill to carry out the plan.

Procedures for the repair of harelip have been thoroughly described and discussed by numerous authors. For the single harelip the Mirault operation, popularized by Blair and later so well redescribed and modified by Brown,[3] is a most excellent procedure and is applicable in a

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From the Section on Laryngology, Oral and Plastic Surgery, Mayo Clinic.

Read before the Section on Laryngology, Otology and Rhinology of the American Medical Association, Atlantic City, N. J., June 11, 1947.

1. Blair, V. P.: The Why and How of Harelip Correction, Ann. Otol., Rhin. & Laryng. **37**:196-205 (March) 1928.

2. Vaughan, H. S.: Wide Nostril in Unilateral Cleft Lip, Tr. Am. Soc. Plast. & Reconstruct. Surg. **12**:117-123, 1943.

3. Brown, J. B., and McDowell, F.: Simplified Design for Repair of Single Cleft Lips, Surg., Gynec. & Obst. **80**:12-26 (Jan.) 1945.

large percentage of cases. It may be necessary, however, to make modifications in order to cope with special problems. The Rose operation occasionally is preferable, especially in cases of incomplete harelip.

In considering the management of the accompanying nasal deformity, emphasis is to be laid, as has been done previously by various authors, on the necessity of building a good floor for the nostril, of freeing the tissues widely so that the nose comes into proper relationship to the face as a whole and, finally, of making the necessary dissections in order to mobilize the alar cartilages so that they can be brought into as nearly normal position as possible. Blair,[1] Vaughan,[2] Brown and McDowell,[3] Davis[4] and others have described these methods well.

For bilateral complete harelip, the Thompson[5] operation combined with the procedure advanced by Veau[6] for closure of the alveolar and anterior palatal clefts has given excellent results. This will be considered later.

Surgical procedures for the repair of clefts of the palate also have been thoroughly discussed and described. For the repair of those clefts which involve only the soft palate or the soft palate and the posterior half to two thirds of the hard palate, I have employed the Wardill type of operation, with gratifying results. I shall not discuss the method in detail but several points are worthy of emphasis.

Wardill[7] mentioned but did not emphasize extending the dissection beyond the base of the hamular process. I am of the opinion that it is important to free the soft tissue from the medial surface of the internal pterygoid plate above and behind the hamular process after this has been disconnected.

It is my practice to extend the dissection 1 to 1.5 cm. above and posterior to the process (proportionately further in adults) (fig. 1*a*). This adds materially to the relaxation of the soft palate. Usually, the descending palatine arteries are sacrificed deliberately.

The soft tissue must be freed entirely from the posterior and medial margins of the palate and from the adjacent nasal surface of the palate over a space at least 0.5 cm. in width (fig. 1*b*). This should be done without perforating the mucous membrane. The medial margins of the cleft and of the uvula are split rather than pared.

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4. Davis, W. B.: Management of Bilateral Cleft-Lip, Tr. Am. Soc. Plast. & Reconstruct. Surg. **12**:99-116, 1943.

5. Thompson, J. E.: An Artistic and Mathematically Accurate Method of Repairing the Defect in Cases of Harelip, Tr. South. Surg. & Gynec. A. **24**:367-380, 1911.

6. Veau, V., and Borel, S.: Division palatine; anatomie, chirurgie, phonétique, Paris, Masson & Cie, 1931.

7. Wardill, W. E. M.: The Technique of Operation for Cleft Palate, Brit. J. Surg. **25**:117-130 (July) 1937.

The mucous membrane flaps obtained from the septum are sutured to those from the lateral wall of the nasal cavity in order to form the floor of the nasal cavity. This line of closure is continued across the upper surface of the soft palate and to the tip of the uvula. I am of the opinion that meticulous attention to this part of the closure is one of the most important factors in obtaining primary healing. After this portion of the closure has been completed, two or three sutures are used to unite the muscles of the two halves of the soft palate. Finally, the mucous membrane of the oral side is closed.

For suture material I use no. 0000 plain catgut throughout the closure. Criticism may be forthcoming as to the choosing of this type of suture material rather than heavy catgut, silk, linen or wire, such as many surgeons have recommended and used. If the tissues have been freed so that closure can be made without

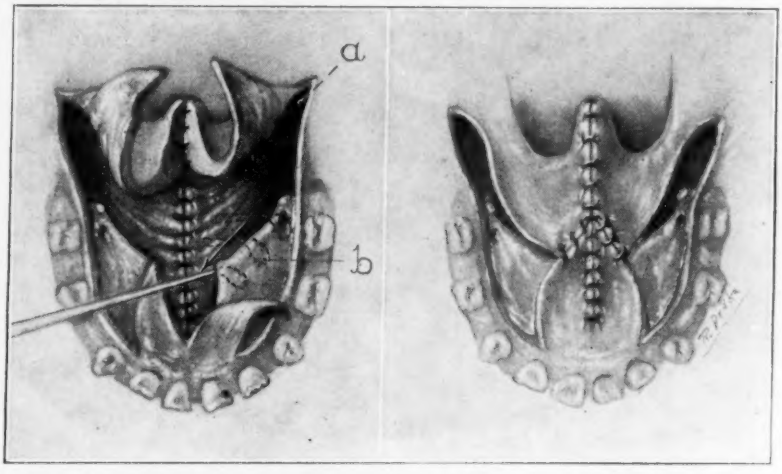

Fig. 1.—Wardill's operation: At *a* note dissection extended above and posterior to the hamular process; at *b*, freeing of the soft tissue from the posterior and medial margins of the bony palate.

tension, suture material heavier than that mentioned is not needed. If there is tension, heavy suture material is likely to cause local necrosis and cannot be relied on to compensate for insufficient relaxing dissection. My experience has been that when closed as described the palate heals with less reaction than when closed with heavy catgut or nonabsorbable suture material. Only rarely is there a postoperative perforation.

After the closure has been completed, a moderately firm iodoform gauze pack is placed in the lateral wound on each side. Especial attention should be given to placing the pack well down into the space created in the region of the divided hamular process. The packs are left undisturbed for fourteen days.

Repair of the incomplete cleft of the palate usually is deferred until the patient is 14 to 16 months of age.

For complete cleft of the palate, either single or bilateral, I prefer the Veau type of operation if the cleft involves the anterior part of the palate and the alveolar process. This method has been described by Ivy and Curtis,[8] but its value warrants reemphasis.

8. Ivy, R. H., and Curtis, L.: Procedures in Cleft Palate Surgery: Experiences with the Veau and Dorrance Technic, Ann. Surg. **100**:502-511 (Sept.) 1934.

In the Veau operation a flap is created on each side of the cleft; on the medial side it is obtained from the septal mucosa, and on the lateral side, from the lateral nasal mucosa.

An incision is made lengthwise along the middle of the exposed inferior border of the septum. This incision begins at a point opposite the second bicuspid or first molar tooth and is carried forward to a point on the premaxilla near the future margin of the gum. The incision then is continued around the premaxilla on the side toward the cleft and follows a line just inside the future margin of the gum (fig. 2). After it has been continued around the premaxilla, it passes upward a short distance to a point on the lower anterior lateral surface of the septum where it will be joined by an incision which will be made later to remove the vermilion

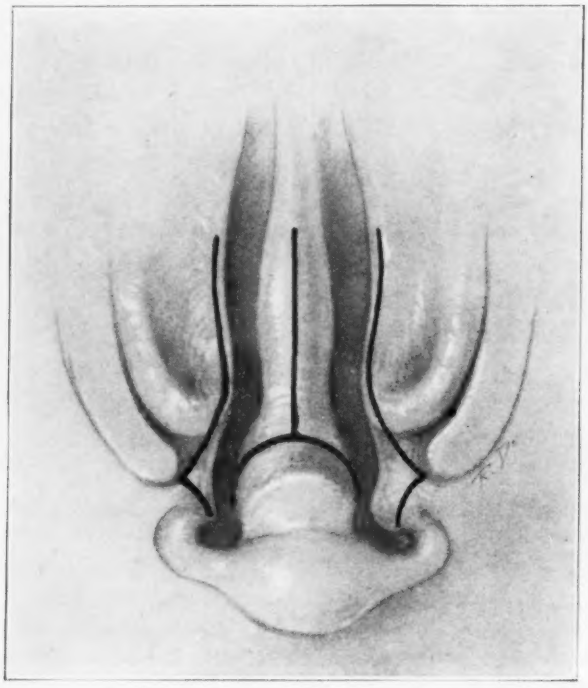

Fig. 2.—Incisions for the Veau type of repair of a cleft extending through the alveolar process and the anterior half of the palate.

line from the prolabium and which will be carried up into the future floor of the nostril just lateral to the base of the columella. A periosteal elevator is used to loosen the mucosa from the septum and from the lateral aspect of the premaxilla throughout the length of the incision. It is difficult to elevate the mucous membrane from the oral and lateral aspects of the premaxilla, and extreme care is necessary to avoid shredding the mucous membrane.

Next, an incision is made along the lateral margin of the cleft, beginning opposite the starting point of the septal incision. This is carried forward onto the alveolar process just lateral to the cleft and to a point near the future margin of the gum. It is then continued around the medial end of the cleft alveolar process on a line just inside the future margin of the gum and finally up inside the ala to a point where it will join an incision which will be made later to create a flap

from the mucosa of the lateral portion of the labial cleft and which will be carried up into the future floor of the nostril just inside the ala (fig. 2). A periosteal elevator is used to loosen the mucosa from the lateral side of the cleft (lateral nasal wall) and from the medial extremity of the cleft alveolar process throughout the length of the incision.

The two flaps thus created are sutured together with no. 0000 plain catgut. Interrupted sutures are used and are placed so that the knots lie on the nasal side (fig. 3*a*). The closure must be carried across the alveolobuccal fold to make a complete floor for the anterior nasal cavity (fig. 3*b*). In the repair of the harelip, which follows immediately, the floor of the nasal vestibule is made from the skin adjacent to the base of the ala and of the columella. Owing to the placement of the connecting incisions which have been described, this vestibular floor becomes an extension of the floor of the anterior nasal cavity.

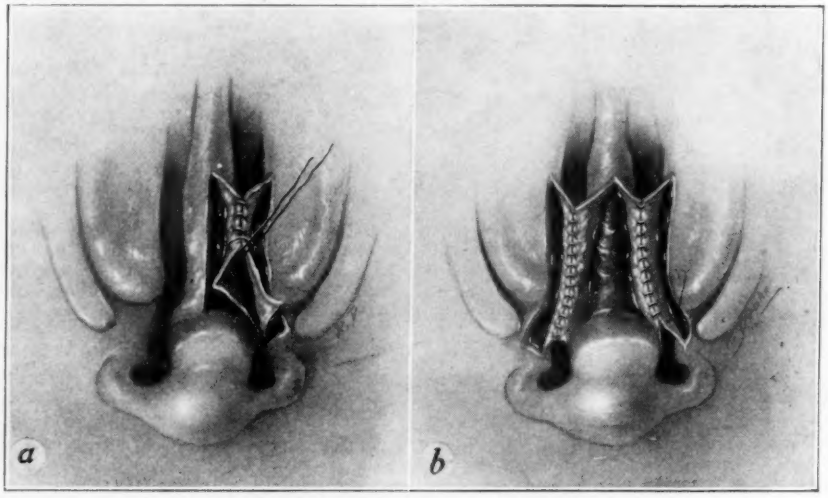

Fig. 3.—Suture of the flaps of mucous membrane: (*a*) Knots are placed on nasal side of the closure; (*b*) bilateral simultaneous closure.

In the Veau operation as originally described, a flap is made by elevating the soft tissue from the oral surface of the anterior part of the palate, and this flap is turned across to cover partially the line of closure of the flaps that have been described. The use of this flap from the palate has been discontinued. If the flaps from the septum and the lateral nasal mucous membrane are prepared so that they can be sutured without tension, they will unite throughout the entire closure, and in the process of healing the raw surface on the oral side will be covered by scar epithelium. The result is that there is an intact floor for the anterior nasal cavity together with complete closure of the alveolar cleft and of approximately the anterior half of the hard palate (figs. 4 and 5). Later, a Wardill type of operation can be used to complete the repair of the palate, or palatal flaps can be grafted and a "push back" operation done.

In cases of single palatal cleft and associated single harelip, the Veau type of closure of the anterior half of the palate and of the alveolar process is combined in a single stage with a Mirault type of repair of the harelip.

In cases of bilateral complete cleft palate and bilateral harelip, the bilateral Veau operation and the bilateral repair of the harelip sometimes can be done as a single operation, or the anterior part of the palate and the lip can be repaired on one side only at one time, and the same operation done on the other side after an interval of ten days to

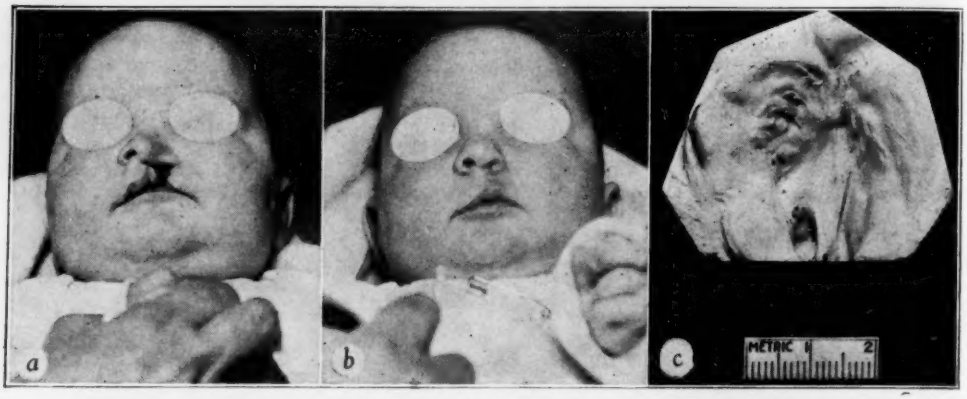

Fig. 4.—(*a*) Complete cleft of left lip, alveolar process and palate. (*b*) Appearance after repair of lip, alveolar process and anterior portion of the palate at one operation. (*c*) Impression made one year later. The palate is closed to a point approximately opposite the first molar tooth. The Wardill type of operation will be used to repair the remainder of the palatal cleft.

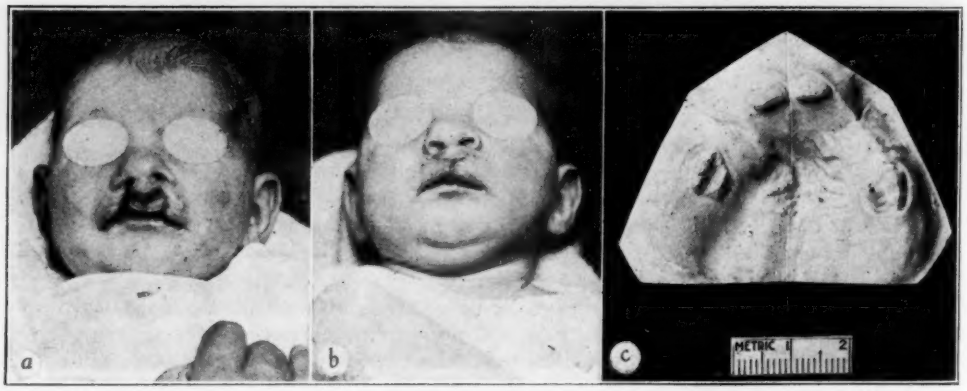

Fig. 5.—(*a*) Complete cleft of the palate and the alveolar process on the right side; there was only a notch in the left alveolar process. (*b*) Appearance after single stage repair. (*c*) Impression made eighteen months after operation. In this impression compare the repaired right alveolar cleft with the left alveolar process, which was only notched.

two weeks (fig. 6*a* and *b*.) Often, the decision whether to use the single stage or the two stage method is not made until the defect of one side has been repaired. If the operation has proceeded thus far smoothly and if the child is taking the anesthetic well and is in good condition, one

can proceed with the repair of the defect of the other side; otherwise, it is better to defer the remainder of the repair until later.

In cases of bilateral cleft of the palate and lip, the Thompson[5] method of repair of the lip is preferred. When the premaxilla projects badly, it usually can be forced back by digital pressure so that the lip can be closed, and only rarely is it necessary to section the vomer. If section of the vomer is necessary, simply dividing it so that the anterior segment can slide back alongside the posterior segment is preferable to removing a portion of it.

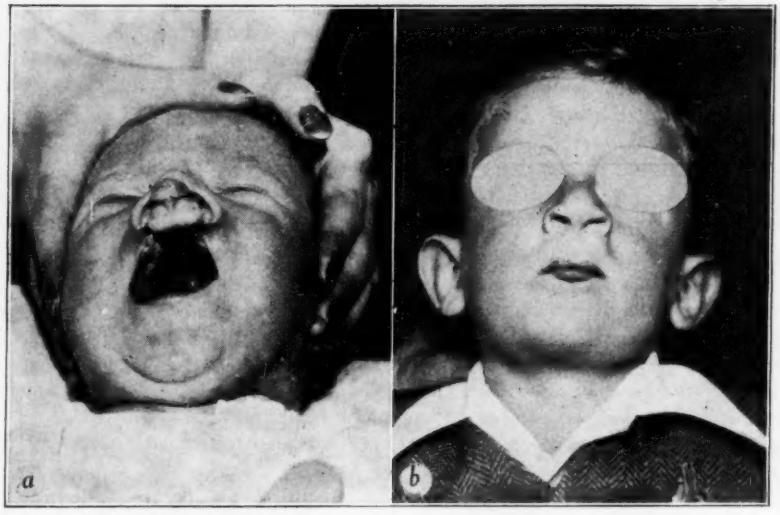

Fig. 6.—(*a*) Bilateral complete cleft of palate and lip. The left side of the anterior half of the palate and the lip were repaired at the first operation; the same operation was performed on the right side two weeks later. The Wardill type of operation was used to complete the repair one year later. The boy has complete closure of the palate with excellent function. (*b*) Postoperative appearance; a further operation, corrective of the lip and the nose, will be done later.

I am fully aware that criticism has been made of the Thompson type of operation for double harelip. However, it is not to be expected that this severe deformity can be corrected satisfactorily by a single operation in infancy. Further plastic operations almost invaribly are needed, and with such subsequent operations the plan outlined has given good results. I agree with Aufricht,[9] who said, "There are two results . . . one is the immediate result, the closure of the harelip, and the other is the late result."

Repair of the anterior half of the palate and the lip in cases of combined complete cleft palate and harelip, either single or double, is made when the patient is 6 or 8 weeks of age provided, of course, that he

9. Aufricht, in discussion on Vaughan.[2]

is in proper physical condition. Closure of the posterior portion of the palate is deferred until the patient is 14 to 16 months of age.

The Veau operation for closure of the anterior portion of the palate and the alveolar process is a tedious one and technically rather difficult, but the gratifying results will repay the surgeon who masters it.

DISCUSSION

DR. HAROLD S. VAUGHAN, New York: Dr. Havens has demonstrated a most excellent technic and has brought out an important point in connection with the Wardill operation, one which also applies to any operation aiming to obtain elongation of the repaired palate. After separation of the hamular process, the dissection must be extended well along the lower and inner borders of the external pterygoid plate. The palate can then be immobilized to permit easy contact with the pharyngeal wall. To obtain free mobilization it is always necessary to section the descending palatine arteries.

Cleft lips are repaired any time after 3 weeks of age, provided the baby is in good condition and shows a steady gain in weight.

In unilateral complete cleft lip-cleft palate, I prefer to approximate the alveolar border as closely as possible by digital pressure, and then repair the lip. The pull of the repaired lip usually approximates the alveolar border.

The soft palate and the posterior part of the hard palate are closed from 18 months to 2 years of age, or later, depending on the width of the cleft. In closing the anterior part of the palate and the alveolar border I prefer a flap from the medial side of the cleft, and I rotate this raised medial flap under the elevated margin of the external side of the cleft. When the cleft in the alveolar border has not narrowed down to contact, a flap from the vomer and the premaxilla is turned over to form the nasal floor. The oral side is then covered with a rotated flap from the medial side of the palate.

In bilateral complete cleft lip—cleft palate with the premaxilla thrust forward, a better late result is obtained if the lip is repaired over a premaxilla that has had the minimum of posterior replacement, as adequate bony support is necessary to prevent the unsightly flat inverted lip. No attempt is made to unite the premaxilla to the alveolar border until sometime after the soft palate and the posterior part of the hard palate have been repaired at around 18 months to 2 years of age. The closure is then made by using vomer and premaxilla flaps to form the nasal floor, together with palate flaps rotated from the two sides to cover the raw surfaces.

Instead of using the Veau method at the time of the repair of the lip, I prefer the later closure, because the vomer and premaxilla flaps are much less likely to shred and tear, for the tissues are then firmer and better developed. The elevating of a flap along the alveolar borders at the time of the primary repair of the lip often damages the tooth sacs, with subsequent lack of maxillary development. I have found that the Thompson operation wastes too much of the philtrum, and tends to produce a lip long from above downward, and short from side to side.

DR. ROBERT H. IVY, Philadelphia: One of the most important points brought out by Dr. Havens is the using of what may be termed the Veau "turn over" mucoperiosteal flap to close the anterior part of the hard palate immediately preceding closure of the cleft lip. I have used this for a good many years and cannot understand why it is not universally employed. It succeeds, in a large percentage of cases, in preventing a fistula extending into the nose beneath the lip. This part

of the operation usually requires only a few minutes, and immediately after it has been done one can perform closure of the lip without subjecting the infant to undue risk.

Closure of the posterior cleft is best accomplished by using Axhausen's modification of the von Langenbeck operation, suturing the nasal mucosa, the muscles of the soft palate and the mucosa of the palate in three separate layers.

Instead of suturing the muscular layer directly, I carry a fine tantalum wire suture around the muscles of the soft palate, holding them together by twisting the ends of the wire which protrude at the midline. Instead of packing the lateral incisions with iodoform gauze, which has to be removed, for three or four years I have used oxidized gauze, which is hemostatic and absorbable. This does not subject the child to the discomfort of removal and possible replacement of the packing. The oxidized gauze disintegrates gradually and disappears.

I am essentially in agreement with Dr. Havens about the age for operation. The operation on the posterior part of the palate, is deferred to the age of 2½ to 3 years. I do not hold with the advocates of early operation who plead that better speech is attained if closure is performed before the child starts to talk. I do not believe that a year or two makes enough difference to outweigh the greater safety of later operation.

I wish to call attention to a simple device for holding up the detached mucoperiosteal flaps against the bone after "push back" operations. For some time now I have accomplished this with a thumb tack on each side perforating the mucoperiosteal flap and penetrating into the bone of the hard palate. To prevent loss of the tack in the throat in case it accidentally comes loose, a hole has been drilled in it near its edge, through which a silk thread or a fine wire is passed and fastened with adhesive plaster to the skin of the cheek.

DR. GEORGE M. DORRANCE, Philadelphia: I am interested in this story of the cleft palate, and there are so many parts of it which Dr. Havens has taken up to just a small extent. I differ with him on the time to start to operate. I operate when the patient is 4 or 5 years of age. The repair of the cleft which he does I think is excellent. I sometimes use the turning over of the flap. One has to learn to build up the floor, and to build the lip on that.

[Several slides were shown and Dr. Dorrance discussed some anatomic considerations relating to palatal repair. He also discussed briefly the Dorrance "push back" operation and a special splint designed by his dental colleague for use during the postoperative period following palatal repair.]

DR. IRVING WILSON VOORHEES, New York: I hesitate to speak again, but no one has said anything so far about the causes of failure of operations for cleft palate. I suppose there are comparatively few failures now, owing to improvements in surgical technic. The technic of Dr. Havens is excellent, and it is bound to insure success in an increasing number of cases. Successes are well over 90 per cent, maybe even 100 per cent, with Dr. Havens' procedure! However, what does one accomplish by complete closures? They all look good when the patient leaves the table. What happens later on? In the first place one has prevented food and liquid from going from the mouth up into the nose—a very desirable thing. That can be done in most cases. One also can secure closure of the soft palate, but later on there is tension, and the patient talks like this [demonstrating]. That hollow sound is undesirable. It can be overcome to some extent by courses of speech improvement, but there is residual tension which cannot be overcome.

In 1938 I sent out a questionnaire to many surgeons in this country—I think about 500 in all—and got replies from about 80 per cent. Many physicians thought

it would be a waste of time even to try to close cleft palates. They had tried and failed; so repair was under a cloud. But at that time failures were due to (1) selecting improper cases, (2) operating in the presence of recent infections of the mucous membrane and (3) cutting off the blood supply to the flap.

Dr. Havens seems not to be particularly interested in the posterior arteries, and so severance may not be really objectionable. Improper placing of sutures and too much meddling after operation may cause failure. I think the tendency to wash out, spray out and "fuss" should be avoided. If one has done a good operation in the first place, nature must do the rest.

As for sutures, a fine chromic gut will suffice, and one does not have to remove it. If healing by primary union is not present within five days to a week, it will not occur; the sutures then become foreign bodies.

Proper postoperative care is a matter of common sense, like everything else in surgery. One may get a good anatomic result and poor function, but if speech training is carried out successfully, these patients often speak understandably. It sometimes happens that one side of the face (superior maxilla) develops poorly. Then there is facial asymmetry.

A successful result calls for complete closure of the cleft, good speech and facial symmetry.

DR. FRED Z. HAVENS, Rochester, Minn.: Possibly I was misunderstood. My colleagues and I do not limit ourselves to the procedures I have been talking about this morning. We use all the various procedures that have been discussed. We use the Dorrance "push back" a good deal.

THE MIDDLE EAR IN SOUND CONDUCTION

ERNEST GLEN WEVER
MERLE LAWRENCE
AND
KENDON R. SMITH
PRINCETON, N. J.

THE PRIMARY function of the middle ear is one of mechanical efficiency. This structure aids in transmitting vibrations from the air to the fluid of the cochlea, in which the sensory cells are placed. Its service in this regard became a practical necessity when in the course of evolution certain of the vertebrates left the sea and appeared on land. Their water ears, which were simple sacs buried deep below the surface of the head, then became nearly useless, just as must be true for a modern fish when brought above the surface. The reason derives from a simple principle of sound transmission.

Sound waves in one medium will not readily enter another medium of different acoustic resistance. Rather, they are reflected back from the boundary. The transmission is easily calculated because it depends on the ratio of the acoustic resistance, and the acoustic resistance of a medium depends only on its density and elasticity. That is, $R = \sqrt{PK}$, where R = the acoustic resistance, P = density and K = elasticity. When R_1 and R_2 are the acoustic resistances of the two mediums concerned, their ratio $r = R_2/R_1$, and the transmission $T = \frac{4r}{(r+1)^2}$. For extended mediums we use in these calculations the bulk modulus of elasticity.

Let us carry out the calculations for air and sea water (the latter of which we presume to be similar to cochlear fluid). For air at 20 C. we find that $P_1 = 0.0012$ Gm. per cubic centimeter and that $K_1 = 1.42 \times 10^6$ dynes per square centimeter. For sea water at 37 C. (body temperature) we find that $P_2 = 1.024$ Gm. per cubic centimeter and that $K_2 = 2.53 \times 10^{10}$ dynes per square centimeter. Hence we obtain R_1 (for air) $= \sqrt{P_1K_1} = 41.5$ Gm. per square centimeter per second, R_2 (for sea water) $= \sqrt{P_2K_2} = 161{,}000$ Gm. per square centimeter per second, and $r = R_2/R_1 = 3{,}880$. Therefore $T = \frac{4r}{(r+1)^2} = 0.001$.

From the Psychological Laboratory, Princeton University.

This work was carried out under contract with the Office of Naval Research as Contract N6 onr-270 Task Order III.

This figure means that only one tenth of 1 per cent of the energy carried through the air will enter the water; the other 99.9 per cent is reflected back from the water's surface. This is a transmission loss of 30 decibels.

If the cochlear fluid were somehow made directly accessible to the air we should expect, from these calculations, that the sounds transmitted to it would suffer a loss of this order of magnitude. Actually the loss must be a little greater, because the calculations are based on the assumption of an extended medium, whereas the cochlear fluid is limited, enclosed in a firm capsule. The effect of the enclosure is to raise the elasticity, increasing the loss accordingly.

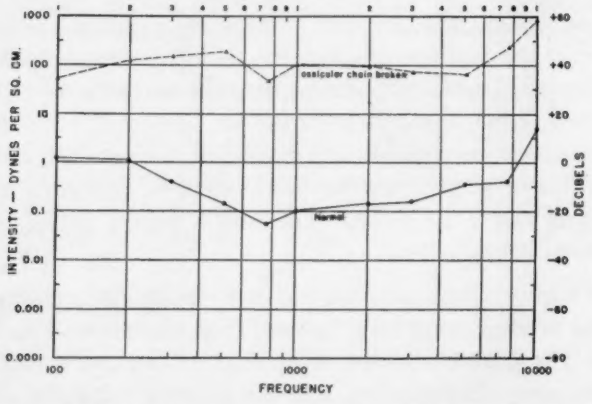

Chart 1.—Effect of breaking the ossicular chain and leaving the drum membrane and the ossicles in situ. The curves show the amount of sound in dynes per square centimeter necessary to produce a standard cochlear response of 10 microvolts under the conditions indicated.

The remedy for a transmission loss like this is a mechanical transformer: a device that provides a better match between the two acoustic resistances. The middle ear is such a transformer, and every one of the air-breathing vertebrates, from the amphibians on, possesses it. One can discover how well it serves its purpose by an experimental procedure in which one removes it and measures the drop in efficiency that follows.

EXPERIMENTAL PROCEDURE

In dealing with the problem we made use of the electrical potentials of the cochlea, which are observed in experimental animals by means of an active electrode placed on the round window membrane, and another electrode grounded in the masseter muscle nearby. All experiments were carried out on cats except one series, in which guinea pigs were used also. The animals were deeply anesthetized with pentobarbital sodium injected intraperitoneally, and in some of the experiments were further immobilized with curare. We used Squibbs purified form of curare ("intocostrin"—1 unit equals 1 mg. of standard d-tubocurarine chloride)

injected into the femoral vein in an amount sufficient to suppress all reflexes and respiratory activity. The animal then was maintained by artificial respiration. The experiments were carried out on 17 ears.

The approach to the middle ear was mediolateral. The bulla was exposed by excision of the parotid gland, the digastric muscle and the hyoid chain, which involved ligature and cutting of the posterior facial vein and the internal carotid artery. Usually the bulla was opened widely to give access to the structures of the middle ear.

From a loud-speaker pure tone stimuli were conducted by a tube to the animal's ear. Measurements of sound pressures were made with a calibrated acoustic probe consisting of a miniature condenser microphone fitted with a front cap and an extending probe tube. The probe tube entered the sound tube through the side and then the two ran concentrically to end in a common plane. Therefore the sound pressures recorded by the probe were those prevailing at the orifice of the sound tube.[1]

After amplification, the cochlear potentials were measured with a General Radio Type 736-A wave analyzer used as a voltmeter. Readings are expressed in microvolts as picked up at the round window.

OBSERVATIONS

We have carried out three series of experiments to study the effects on conduction of eliminating the middle ear apparatus. The first showed the effect of simple interruption of the ossicular chain.

Effect of Breaking the Ossicular Chain.—Measurements were first made for the normal condition, with the middle ear intact. The pinna was removed, and the sound tube with its contained probe was inserted deep in the external auditory meatus as close to the drum as practicable, within about 3 mm. on the average. The ear was then stimulated with various tones, and the resulting cochlear potentials were recorded. Also, without disturbing the arrangement in any way, readings were taken from the acoustic probe to determine the sound pressures applied. The lower curve of chart 1 illustrates the cochlear potentials obtained under these conditions. This is an equal response curve; it represents at various frequencies the amount of sound in dynes per square centimeter required to produce a standard response of 10 microvolts.

Then the ossicular chain was broken at the incudostapedial joint. Care was taken that the parts were clearly separated. This is necessary because the natural tensions of the suspensory ligaments and muscles will often reestablish some degree of contact. It was sometimes necessary to remove a minute piece at the end of the incus to assure a positive gap. The drum membrane and the outer ossicles remained in position, and the stimulating apparatus was undisturbed, so that the sounds continued to

1. The calibrated microphone and probe tube were lent to us by the Bell Telephone Laboratories. The probe was designed and calibrated by Dr. F. M. Wiener.

be delivered to the drum. Readings of cochlear potentials were taken under these conditions, and the sound pressures were ascertained with the acoustic probe as previously. The results are shown in the upper curve of chart 1.

We observe as a result of this operation a profound loss of sensitivity. For tones of the middle range the loss is of the order of 60 decibels; for lower and higher tones, somewhat less. This loss is far more than our theoretic analysis leads us to expect simply from elimination of the transformer action. The reason is not far to seek: The drum membrane and the outer ossicles now are not only useless but detrimental. Interposed between the incoming sound and the functioning structures, they reflect and absorb the sound waves to no purpose. This fact was proved in the series of experiments now to be described.

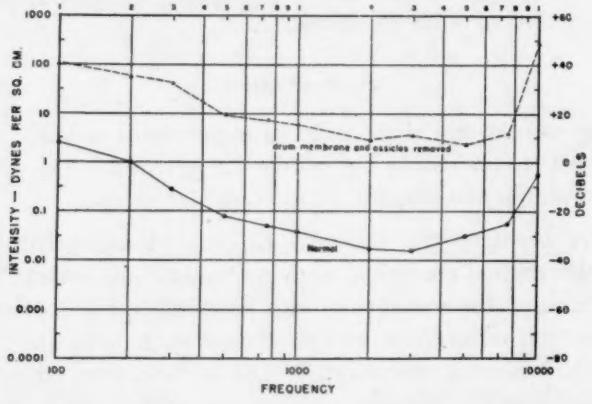

Chart 2.—Effect of removing the drum membrane and the two outer ossicles.

Effect of Removing the Drum Membrane and the Two Outer Ossicles.—In this series of experiments, after the normal sensitivity was obtained as before, the incudostapedial joint was broken, and the drum membrane and the two outer ossicles were removed. The sound source remained at its former position in the external auditory meatus. The resulting function is shown in the upper curve of chart 2. The loss of sensitivity was around 45 decibels in the middle range and 35 to 40 decibels elsewhere. It is evident that the removal of the parts obstructing transmission after the ossicular chain is broken aids the transmission by 10 or 15 decibels for tones in the middle range. This effect is less for the low and the high tones.

We have in this situation the cavity effects of the external meatus and the tympanum, which now are joined as a single space that has been opened at one side. The sound waves are measured at the entrance

of this cavity. They penetrate to the inner ear only after they have been modified by the cavity. The next step was to eliminate the effects of the cavity.

Effect of Eliminating All of the Middle Ear Except the Footplate of the Stapes.—After a normal sensitivity curve was obtained in the manner already described, the ossicular chain was broken at the incudostapedial joint, and the peripheral structures, including the drum membrane, the malleus and the incus, were removed. The lateral wall of the tympanic space was dissected away to give free access to the cochlea. Then the crura of the stapes were carefully removed, leaving only the footplate in position in the oval window. The sound tube was brought close over the oval window and sealed in with wax. The sound pressures

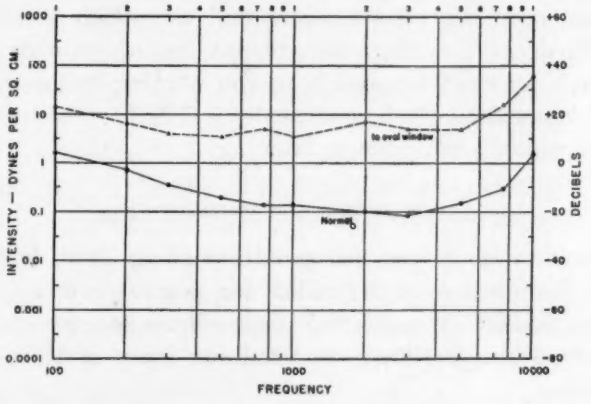

Chart 3.—Effect of eliminating all of the middle ear except the footplate of the stapes, which remained in the oval window. The upper curve represents the sensitivity of the ear when the sound stimuli were directed to the oval window under these conditions.

were obtained from the readings of the acoustic probe as before. Stimuli were then delivered at this position and the cochlear potentials measured. Some of the results are shown in the upper curve of chart 3.

The loss is greatest in the middle range, and less for the high and the low tones. In this example the loss was between 30 and 35 decibels in the region of 750 to 2,000 cycles and tapered off to 18 decibels at 100 cycles and 27 decibels at 10,000 cycles. Among different ears this pattern varied only moderately, and mainly in the amounts of loss for the extreme tones. For the middle range a representative figure is 33 decibels, for the low range, 24 decibels, and for the high range, 26 decibels; 28 decibels may be taken as an over-all figure.

The results were not very different when the stapes was left intact Possibly there was a little greater loss for the high tones.

The results of these experiments, uncomplicated by the presence of nonfuctioning parts or a cavity as were the two foregoing series of experiments, show clearly the degree to which the transmission system of the middle ear serves acuity. Now we inquire into the methods by which this service is rendered. The physical problem presented in matching the impedance of the air with that of the cochlear fluid is one of gaining a mechanical advantage for the light particles of air so that their momentums will be imparted as completely as possible to the heavier particles of liquid. We confront much the same problem when we seek with our limited strength to raise a heavy weight, and we solve it by resorting to levers, pulley blocks and similar mechanisms.

The transformer ratio needed to give the ideal sound transmission can be calculated either on a theoretic basis or from the empiric data now at hand. Theoretically it is the square root of the quotient of the acoustic resistances of sea water and air, which is 63 to 1. If we take 28 decibels as the representative loss of sensitivity after the middle ear is removed, we shall have (on working backward from this value of transmission, which numerically is 0.0016) a transformer ratio of 50 to 1, which is not quite so large.

HYPOTHETIC CONSIDERATIONS

Helmholtz[2] clearly saw this problem and in 1863, in his famous treatise on the functions of the middle ear, pointed to three mechanisms that he considered as combining their effects to give the necessary mechanical advantage. These included two kinds of lever and a hydraulic system.

1. *The Drum Membrane Lever Hypothesis.*—In his theorizing Helmholtz attached the greatest importance to a kind of lever action that he conceived of in regard to the movements of the drum membrane and the malleus. As he pointed out, the drum membrane has a conical form, and the manubrium of the malleus runs from edge to apex along its superior radius. He supposed that as the apex moves in and out under the influence of sounds the malleus slides back and forth largely in a radial direction, and its movements are less in amplitude but greater in force than those of the drum membrane itself. The principle is familiar in the "hanging chain" problem handed down from the ancient mathematicians, in which it is brought out that the force exerted by the weight of a chain or a string stretched between two supports is such as to prevent its being straightened out, however great the horizontal pull

2. Helmholtz, H. L. F.: Die Mechanik der Gehörknöchelchen und des Trommelfells, Arch. f. d. ges. Physiol. 1:1-60, 1868; On the Sensations of Tone as a Physiological Basis of the Theory of Music, New York, Scribner & Walford, 1885, pp. 134-135.

exerted at the attachments. The mechanical advantage that the downward force has in opposing the straightening depends on the angle made with the horizontal line; numerically it equals the reciprocal of the sine of this angle, and therefore for very small angles it approaches infinity.

Helmholtz did not attempt any quantitative estimate of this action in the ear, but it can be worked out on the basis of a rough determination of 16 degrees as the angle between the axis of the manubrium and the tympanic ring.[3] If we think first, as Helmholtz evidently did, of the simple string analogy, then when such a string makes a 16 degree angle with the supports a force exerted at the center will be magnified 3.6 times at the two supports. However, in the ear drum we have not just two but many strings, and we need to develop the problem further. The force (which we can think of as applied at the apex) is not resolved in the one direction that the malleus takes but is distributed along the other radiuses as well. Since the malleus covers about one twelfth of the drum area, it ought to have this proportionate part of the whole force. Hence the effective force is 3.6/12, or three-tenths of the applied force, which comes out as a loss rather than a gain. Evidently this theory proves of no benefit to our problem. Further, we object to the basic assumption that the malleus slides on the drum membrane along a radial line. It is more reasonable to suppose that these parts simply move together.

We have no empiric evidence on this hypothesis, as we have been unable to devise any procedure for making a test of it. We reject it on the foregoing deductive grounds and from the indirect evidence, as we shall show, that there are other adequate means of accounting for the middle ear's transformer action.

2. *The Hydraulic Ratio.*—Helmholtz' second principle depended on the difference in areas of drum membrane and oval window. The total force that the air particles exert on the surface of the drum membrane is transmitted through the ossicular chain to the footplate of the stapes and there applied to the cochlear fluid. The transformer ratio is simply the ratio of areas, which Helmholtz estimated for man as between 15 and 20. Even now we have no extensive measurements of this ratio in the human ear. We have determined it in one specimen as 18.2 for the left ear and 19.1 for the right. Whittle[4] measured the drum membrane—oval window ratio of the guinea pig ear and on 8 specimens obtained the following values: 27.6, 27.8, 28.3, 27.8, 26.2, 26.1, 30.4 and 30.9. The mean of these is 28.1. The accompanying table gives a few

3. Wever, E. G.: The Acoustic Characteristics of the Ear, in Harriman, L. P., and others: Twentieth Century Psychology: Recent Developments in Psychology, New York, Philosophical Library, Inc., 1946, pp. 371-386.

4. Whittle, G. T.: The Drum-Oval Window Relationship, Thesis, Princeton University, 1946.

results obtained on the cat. The mean of these four drum membrane—footplate ratios is 36.5. Obviously, there are large variations among species and among ears of one species.

If we take the figure 36.5 as representative for the cat, we must reduce it somewhat because the effective area of the drum membrane is less than its anatomic area. The entire membrane does not move, because its edges are fixed. What we must picture is a central portion that is rigid enough to move practically as a unit, and a bounding ring that exhibits a motion grading down to zero at the edges. We can think of the drum membrane as effectively a simple piston whose area is somewhat smaller than the area of the drum membrane. We can only estimate this effective area; perhaps it is about three fourths of the total area.

Areas of Structures of the Middle Ear in Square Millimeters

Cat	Drum Membrane	Footplate of Stapes	Oval Window	Round Window	Ratio of Drum Membrane to Footplate
1, right	43.7	1.33	1.27*	3.08	32.7
1, left	36.0	1.07	1.12	2.87	33.5
2, right	46.5	1.09	1.20	2.78	42.6
2, left	41.0	1.10	1.21	3.29	37.3

* Note that in this ear the oval window is slightly smaller than the footplate of the stapes. This can happen because the footplate is inserted in a groove on the external rim of the aperture.

In these considerations we discover the value of the drum membrane's conical form. This form adds rigidity to the central portion and makes the effective area larger than it would be for a plane membrane. Loud-speaker diaphragms are given a conical shape for the same reason.

If we take a real ratio of 36.5 and reduce it to three fourths, we have an effective ratio of 27.4, which means that from this hydraulic action the pressure exerted at the stapes is 27.4 times that at the drum. This pressure ratio corresponds to an impedance ratio of 27.4^2 or 750, and a calculation of the power transfer on this basis gives 0.54, which means that by the aid of this hydraulic action, 54 per cent of the aerial energy is communicated to the cochlear fluid. This is not perfect transmission but is substantial nonetheless. Now the power loss is only 2.6 decibels instead of 30 decibels.

3. *The Ossicular Lever Hypothesis.*—Helmholtz suggested further that the ossicles form a simple lever system in which the stapedial movements are smaller in amplitude but greater in pressure than the movements of the drum membrane. From measurements of the parts and estimations as to their axes of rotation he adopted 1.5 to 1 as the lever

ratio. Stuhlman[5] more recently worked with a large scale model made of metal and reached the surprising conclusion that the lever ratio is not constant but variable. He stated that when the joint between malleus and incus was locked the ratio was 1.27 to 1 and that when it was loose the ratio was 2 to 1 for inward motion and 1 to 1 for outward motion.

The difficulty with these conjectures is that they rest decisively on where the axes of movement are presumed to be, and a system of so complex a form, suspended as it is by ligaments and muscles, admits of a great deal of freedom in these presumptions. It is certain that considerations based on assumed conditions and on models objectifying these conditions will not give a solution of the problem.

We have tried two experimental approaches. In one we used a mechanical vibrator to drive alternately the manubrium of the malleus and the stapes. The vibrator was a Rochelle salt crystal of the expander type, 5/8 by 5/8 inches (1.5 by 1.5 cm.) in cross section and 3 inches (7.5 cm.) long, to which was attached a "bakelite" rod and at the tip of the rod a fine steel needle. First we made a set of measurements of the cochlear potentials with the point of the needle bearing on the drum just over the end of the manubrium. Then we made measurements while driving the stapes. Here two procedures were used, one in a series of 3 guinea pigs and another in a series of 3 cats. In the guinea pigs, the ossicular chain was disarticulated, and the needle was placed directly on the head of the stapes in line with the long axis of the stapes. In the cats, the chain was left intact, and the needle was introduced through a small hole in the drum membrane. It was applied to the edge of the head of the stapes or near the end of the long process of the incus at the point where this process makes its elbow bend; the latter placement permits a better lining up with the axis of the stapes.

From an acoustic standpoint the situation that we have here is far from simple, and we are quite conscious of its drawbacks. We have used it for want of a better one to discover what happens. We do not know what the effective impedance of our driving system is; certainly it varies with frequency. Doubtless it is greater than that of the cochlear fluid, in which case a lever in the ossicular chain which reduced the amplitude but increased the pressure (as Helmholtz assumed to be true) would be worse than none, and driving the malleus would give smaller potentials than driving the stapes directly.

Chart 4 gives results from one of our more successful experiments, done after we had learned how to cope with at least the more obvious of the technical difficulties. Here the cat was used, the needle was applied to the stapes through a slit in the drum membrane without disartic-

5. Stuhlman, O., Jr.: The Non-Linear Transmission Characteristics of the Auditory Ossicles, J. Acoust. Soc. America **9**:119-128, 1937.

ulation, and the bulla was kept closed after the surgical work was done. The curves are equal response functions. The solid line curve is for placement on the malleus, and the broken line curves represent two different placements on the stapes. The stimuli are not known in absolute terms, but only relatively, so that the shapes of the curves are of no significance. Their differences, however, at any one frequency are the differences of input necessary to give the standard response of 10 microvolts and hence represent differences of sensitivity. The differences between the two stapedial curves give some notion of the reliability of the results. Most of the time the malleus curve is below the others, but it crosses these at several points. At times the differences are 6 decibels or more. From these results we would not argue for the presence of an

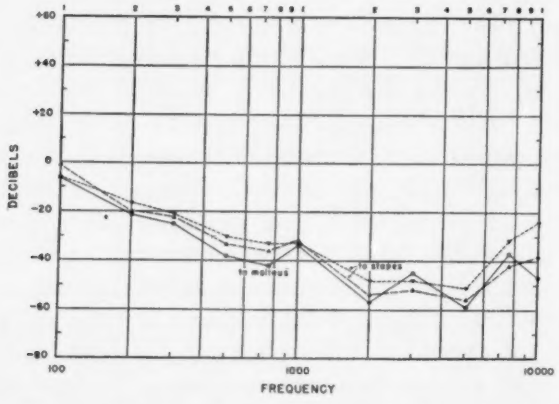

Chart 4.—The results observed when the ossicular lever hypothesis was tested by driving alternately the malleus and the stapes. The curves show the amount of sound necessary, in decibels with respect to an arbitrary input of 1 volt, to produce the standard response of 10 microvolts under the conditions indicated.

ossicular lever system; the differences, for what they are worth, are in the wrong direction. On the other hand, because the differences are small and vary somewhat unsystematically, we are unable to exclude the possibility. We can say only that the effect of such a system if it exists is of the order of the experimental error under these conditions.

Our second approach to the problem was technically simpler. It was based on the consideration that an ossicular lever action as ordinarily conceived requires relative motion between malleus and incus. We inserted a small rubber wedge between the manubrium of the malleus and the long process of the incus to impede any such motion. In the cat, these processes can be approached within the bulla, and a wedge of soft rubber can be thrust between them firmly enough to remain in place. One of our wedges tapered from 1.3 mm. at one end to 0.8 mm. at the other, was 2 mm. long, and weighed 2.4 mg.

Chart 5 gives the results when the animal was stimulated with aerial sounds in the ordinary way. The solid line curve represents the normal sensitivity, and the broken line curve the sensitivity in the presence of the wedge. For the high tones the differences are negligible. For the low tones the presence of the wedge impairs the sensitivity by amounts up to 6 decibels. This result can be interpreted in favor of a lever action for the low tones, but such an interpretation raises the question how we can have such action for these tones and not for the others. An alternative interpretation is that the wedge, by spreading apart the malleus and the incus a little, has increased the stiffness and damping encountered at both the drum membrane and the oval window. This interpretaton we

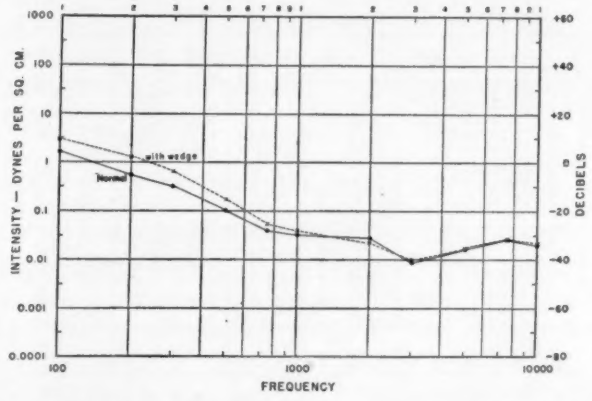

Chart 5.—The results when the ossicular lever hypothesis was tested by inserting a wedge between the malleus and the incus.

prefer because such changes of stiffness and damping would give the kind of frequency differentiation shown, discriminating against the low tones.

We are left without any final conclusion concerning the ossicular lever problem, but we have the assurance that if the lever action is present it is not of any great momen. No doubt we should have had this conviction at the outset. Helmholtz' estimate of a ratio of 1.5 to 1 would give only the modest gain of 2.5 decibels when added to the effect of the hydraulic ratio. And if our calculations of the hydraulic ratio are correct, we have only the small margin of 2.6 decibels for any other factor to operate in. This consideration lends credence to the "columella theory" of ossicular action, according to which the chain operates as though its joints were locked, and the stapedial movements are the same as the movements of the drum membrane.[3]

Here no doubt the question will arise whether the ossicular chain as developed in the mammals carries any advantage over the simple columella possessed by amphibians, reptiles and birds. The answer lies, we think, not in efficiency of conduction but rather in the provision of a

protective device. The tympanic muscles in acting on the ossicular chain are able to restrict its motions and reduce the transmission of sounds of dangerously large amplitudes.

OTHER IMPEDANCE CONDITIONS

To these three conditions of classic note we add others of less definite kind that derive from the peculiar form of the ear and the fact that it is located deep in the head. In the broad view we have to consider the diffraction of the head, the resonances of the cavity of the external auditory meatus and the middle ear, and the mechanical resonances of the moving parts. In our experimental situation, because we have made our

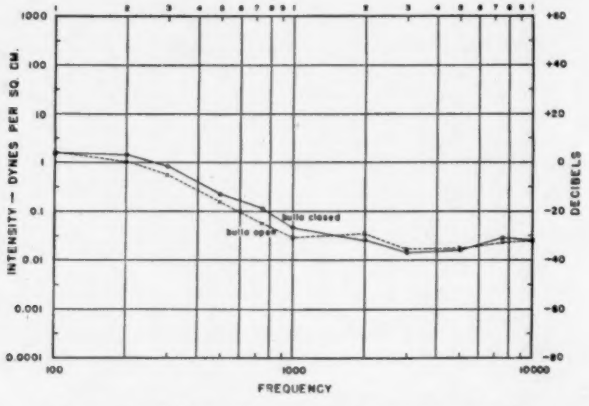

Chart 6.—Effect of opening the auditory bulla.

measurements of tonal intensity at the drum membrane or beyond, we have eliminated the more peripheral of these conditions.

We have already had some indication of the general effect of the tympanic cavity. Now we turn to a more specific question that has arisen frequently for technical reasons: the effect of opening the auditory bulla. This question is concerned in the evaluation of results in the various experiments employing the cochlear potentials where such a modification of the normal state of the ear is made.

If, as we have described earlier, the bulla is entered through a round reamed hole, it can later be closed with a rubber stopper. Actually, in the procedure that we follow,[6] two holes are drilled, a small one of 2 or 3 mm. diameter near the jugular process of the occipital bone, immediately over the round window, and another, usually larger, of 3 to 5 mm. diameter, farther toward the mesial side. The operator applies the electrode through the smaller hole while looking through the larger. The electrode is a foil attached to a wire threaded through a stopper fitting

6. Wever, E. G.; Bray, C. W., and Lawrence, M.: The Effects of Pressure in the Middle Ear, J. Exper. Psychol. **30**:40-52, 1942.

the smaller hole. Then another stopper can be inserted into the larger hole to restore the bulla to its normal closed condition.

A possible complication in the closing of the bulla is that by inserting a stopper in the ordinary way one may inadvertently raise the air pressure in the middle ear and thereby alter the ear's sensitivity. We avoided this possibility by using a stopper through which a fine hypodermic needle had been run. After inserting it, we allowed time for equalization of any pressure differences set up and then closed the needle opening by sliding a bit of cover glass over it.

Chart 6 shows the difference in the pattern of sensitivity of an ear with bulla closed (solid line) and with bulla opened by a 3 mm. hole (broken line). The differences are not outstanding; they attain 5 decibels at but one point. For the low tones the open condition is more favorable, while for the high tones the reverse is true. Plainly, in the normal condition the elastic reaction of the tympanic cavity aids the reception of the high tones.

CLINICAL APPLICATIONS

Some of the conditions which we produced experimentally are encountered in clinical experience. An erosion of the ossicles as a result of otitis media can cause an interruption of the continuity of the chain and produce the grave losses, up to 60 decibels or so, observed in the first series of experiments. The results of the second series suggest that surgical intervention in such cases, with removal of the useless ossicles, ought to restore an appreciable portion of the loss.

These observations apply also to the conditions of conduction encountered in otosclerosis. In that disorder the impairment of sensitivity resulting from complete fixation of the stapes is extreme, even exceeding 70 decibels. As we see the matter in the light of these results, such a loss arises in a combination of conditions. One is the absence of the transformer action, which accounts for perhaps 25 to 30 decibels. Another is the obstruction interposed by the nonfunctioning ossicular chain. In the experiments this condition reduced the sound transmission by 10 to 12 decibels, but in otosclerosis we must expect its action to be even more severe. The ossicles are now firmly anchored in the bone of the cochlear capsule and so constitute a stouter barrier to the sound because they reflect on the drum membrane the mass and rigidity of this anchorage. It is obvious that some part of the beneficial effect of the fenestration operation comes from the interruption of the ossicular chain and the removal of this crippling load on the drum membrane. Thereafter, sound waves pass into the tympanum more easily.

One of the oldest questions of sound transmission concerns the part played by the round window, and specifically whether it provides an alternative path by which vibrations may gain access to the cochlear

fluid. DuVerney[7] discussed the problem in 1683 and suggested that aerial vibrations in the tympanic cavity pass directly through the round window to the inferior portion of the cochlea. The matter is debated even now, and of late has grown in importance in consideration of the manner in which sounds are transmitted in otosclerosis after the modern surgical treatment in which a new window is opened into the labyrinth (the Lempert fenestra nov-ovalis operation).[8] How the round window serves in this situation is of intriguing interest. It is conceivable that it now forms the principal path of sound waves.

This question has wider implications in its relation to certain theories of the essential activities of the inner ear. A group of auditory theories known as the wave theories depend on the assumption of specific modes

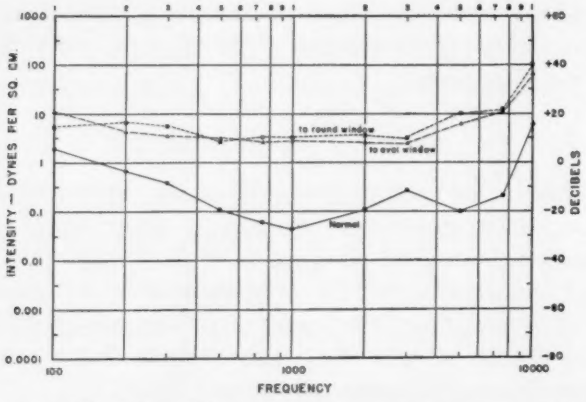

Chart 7 (cat 595 R2).—Effect of stimuli applied to the cochlea by way of the oval window compared with effect of stimuli applied by way of the round window.

of travel of vibrations entering the cochlea. Hurst,[9] for example, assumed that a wave motion began at the stapes, extended up the scala vestibuli to the helicotrema and then ran down the scala tympani until it was finally damped out. The proponent of such a theory would be embarrassed by sound entering in the contrary direction.

In these experiments the function of normal sensitivity was obtained; then the structures of the middle ear were removed and the cochlea fully exposed as described earlier. Only the footplate of the stapes remained in the oval window. The sound tube with its probe was sealed over the oval window and the function obtained as shown by the dash curve of chart 7. Then the sound tube was removed from this position

7. DuVerney, J. G.: Traite de l'orange de l'ouie, contenant la structure, les usages et les maladies de toutes les parties de l'oreille, Paris, E. Machallet, 1683.

8. Lempert, J.: Fenestra Nov-Ovalis: New Oval Window for Improvement of Hearing in Cases of Otosclerosis, Arch. Otolaryng. **34**:880-912 (Nov.) 1941.

9. Hurst, C. H.: A New Theory of Hearing, Tr. Liverpool Biol. Soc. **9**:321-353, 1895.

and sealed in a corresponding manner over the round window, and the function obtained as shown by the dotted curve.

We find the last two curves to be remarkably similar in form. They lie close to one another and take the same course over the frequency range. We can speak, therefore, of the ready entrance and effectiveness of sounds applied at the round window. There are indeed small differences, never exceeding 4 decibels. These in general favor the oval window for transmission. The differences, though small, are consistent enough to be considered significant. Possibly the presence of the stapedial footplate accounts for them; this point remains obscure. We have tried to study it further by removing the footplate, but the consequent leakage of perilymph spoils the test.

To show the consistency of these results we present in chart 8 a second set, obtained on another ear by the same procedure except that

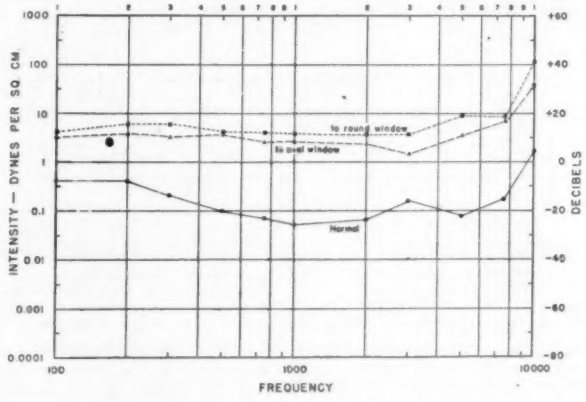

Chart 8 (cat 596 L3).—Effect of stimuli applied to the cochlea by way of the oval window compared with effect of stimuli applied by way of the round window.

the stapes was left intact. Here the differences are a little larger, attaining 8 decibels at times and always in favor of the oval window. Still the general course of the curves is the same.

The evidence presented here will make necessary some extensive revisions of certain of the theories of cochlear activity. A theory like Hurst's which requires the systematic progress of a wave through the cochlea is definitely ruled out.

We see in these results another phenomenon of interest: The sensitivity function of the inner ear is strikingly different in form from that of the ear as a whole. Now the two regions of maximal response that usually are found in the cat's sensitivity function around 1,000 and 5,000 cycles per second no longer appear. The curve is remarkably flat over its main course and then swings upward for the high frequency end.

Sometimes, as in chart 7, there is a slight rise toward the low frequency end as well.

The differences in the functions shown for the normal and the "reduced" ear represent the over-all selectivity of the middle ear system. This characteristic, obtained separately for the two ears illustrated, is presented in chart 9. We have plotted here at each frequency the difference in decibels between the normal sensitivity and that observed when the sound is applied at the oval window. We use the oval window response as the reference level, so that specifically the curves show how much less intense the sound may be when the middle ear is present to give the standard response. Thereby we make obvious the particular efficiency and resonance characteristics of the middle ear apparatus.

Occasionally we encounter an ear in which the normal sensitivity function shows only a single broad resonance instead of two. Chart 1 is an example. When we obtain the middle ear characteristic in such a case it resembles that shown in chart 9 except for a flattening in the middle region. We have some indications that when ears have suffered

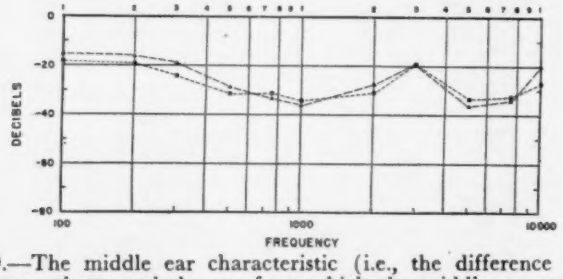

Chart 9.—The middle ear characteristic (i.e., the difference in sensitivity between the normal ear and the ear from which the middle ear mechanism has been removed) for the ears whose function curves are shown in charts 7 and 8. For any given frequency, the distance below the zero line shows in decibels the gain in sensitivity afforded by the middle ear mechanism.

from otitis media not only is their general sensitivity impaired but the usual form of the middle ear characteristic is thus altered. Such changes are to be expected, because the thickening of membranes and the accumulation of scar tissue resulting from an earlier infection would add damping to the moving system and blunt the complex resonances that evidently underlie the usual middle ear function.

The picture presented here is, of course, peculiar to the cat; other animals may be expected to give different characteristic curves.

SUMMARY

These experiments show in quantitative terms the service of the middle ear in aiding the reception of sounds. The drum and the ossicles operate as a mechanical transformer to match the impedances of air and cochlear fluid and thus facilitate the transfer of acoustic energy. The efficiency gained thereby is demonstrated in three series of experi-

ments on cats in which the electrical potentials of the cochlea are measured before and after the normal mechanism has been subjected to various kinds of surgical interventions. The results throw light not only on the normal mechanism but also on its pathologic modifications and impairments.

When the ossicular chain is broken at the joint between the incus and the stapes, but the drum membrane and the outer ossicles remain in place, the loss of sensitivity is profound. It amounts to 60 decibels in the middle range of tonal frequencies and a little less for higher and lower frequencies. The loss is moderated when the drum membrane and ossicles are removed, because these useless parts have obstructed the entrance of the sound waves. Now the loss is around 45 decibels in the middle range and 35 to 40 decibels elsewhere. If the superficial parts of the meatus and the outer tympanic wall are removed, so that the cavity is obliterated, and the sound presented directly to the stapes, the loss is reduced further, to 33 decibels in the middle range and to an over-all average of 28 decibels.

The first two series of experiments correspond to clinical conditions that sometimes are met with. The last shows specifically the transformer action of the middle ear. The over-all average of 28 decibels closely approaches the value calculated for an ideal transformer action, which is 30 decibels. The differences observed between the "reduced" ear and the normal ear give the sensitivity characteristic for the middle ear.

An examination is made of the particular means by which the transformer action is achieved. The evidence does not favor a lever mechanism of the drum that Helmholtz proposed, and is inconclusive regarding a lever mechanism of the ossicular chain that he favored also. His third suggestion of a hydraulic mechanism provided by the larger area of the drum membrane in relation to the stapedial footplate is substantiated. This hydraulic ratio, according to our calculations, will account for a gain of sensitivity of 27.4 decibels—almost the whole of that which the tests demonstrate.

Cavity effects are of importance, as shown by the difference of 10 to 15 decibels between the second and the third procedure mentioned. Opening the auditory bulla when the system remains otherwise intact has only a minor effect.

The experiments show further that when the middle ear mechanism is absent the cochlea is stimulated almost as readily by way of the round window as by way of the oval window. This observation is relevant to conceptions of the fundamental action of the cochlea, and rules out certain of the wave theories that depend on a specific mode of application of the sound energy. The results apply also to the problem of the manner of stimulation of the ear in otosclerosis and after the fenestration operation.

THROMBOPHLEBITIS OF THE CAVERNOUS SINUS ORIGINATING FROM ACUTE DENTAL INFECTION

Cure with Penicillin

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SINCE GOODHILL[1] first published the report of a case of cavernous sinus thrombosis with recovery through the use of penicillin, there have been many other reports of the same nature.[2] The cases reported

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From the Department of Otolaryngology, American University of Beirut.

Dr. H. A. Yeni-Komshian and Dr. Cedric Haddad gave assistance and advice during the patients' stay in the hospital.

1. Goodhill, V.: Penicillin Treatment of Cavernous Sinus Thrombosis, J.A.M.A. **125**:28 (May) 6 1944.

2. (*a*) Wolf, J. W.: Thrombosis of the Cavernous Sinus with Hemolytic Streptococcic Bacteremia, Arch. Otolaryng. **40**:33 (July) 1944. (*b*) Nicholson, W. M., and Anderson, W. B.: Penicillin in the Treatment of Cavernous Sinus Thrombophlebitis: Recovery with Unilateral Ascending Optic Atrophy, J.A.M.A. **126**:12 (Sept. 2) 1944. (*c*) Ramogosa, J., and Rackley, G. D.: Orbital Cellulitis with Severe Cerebral Symptoms (Possibly Cavernous Sinus Thrombosis): Successful Treatment with Combined Sulfonamide-Penicillin Therapy, New Orleans M. & S. J. **97**:276 (Dec.) 1944. (*d*) Conte, A. J.: A Case of Acute Cavernous Sinus Thrombophlebitis with Staphylococcus Septicemia Treated with Penicillin Resulting in Complete Recovery, Laryngoscope **55**:128 (March) 1945. (*e*) Johnstone, D. F.: Cavernous Sinus Thrombosis Treated with Penicillin, Lancet **1**:9 (Jan. 6) 1945. (*f*) Henner, R., and Ridall, E. G.: Thrombosis of a Cavernous Sinus Treated with Penicillin and Heparin, Arch. Otolaryng. **41**:295 (April) 1945. (*g*) Greenish, B. V. I.: Cavernous Sinus Thrombosis, Brit. M. J. **1**:876 (June 23) 1945. (*h*) Belsky, H.: Cavernous Sinus Thrombosis with Recovery (Following Use of Penicillin), New York State J. Med. **45**:1773 (Aug. 15) 1945. (*i*) Sears, T. P., and Wilson, F. L.: Recovery from Cavernous Sinus Thrombosis and Staphylococcic Pneumonia by Combined Use of Penicillin, Sulfadiazine (Sulfonamide) and Antistaphylococcus Serum: Case Report, Rocky Mountain M. J. **42**:838 (Nov.) 1945 (*j*) Welty, R. F.: Bacterial Thrombophlebitis of Cavernous Sinus with Recovery, Arch. Otolaryng. **43**:70 (Jan.) 1946. (*k*) Young, D. H.: Cavernous-Sinus Thrombosis Treated with Sulphonamides and Penicillin, Lancet **1**:346 (March 9) 1946. (*l*) Barcia, L. G.: Penicillin Therapy of Thrombophlebitis of Cavernous Sinus: Case, Med. españ. **14**:538 (Dec.) 1945. (*m*) Doménech-Bladé, R, and Giménez Andreu, G.: Penicil-

have been those of cavernous sinus thrombosis originating from various septic lesions over the face and in the nose. A case following infection of the antrum has been reported.[3]

In searching the literature, we found only 1 reported case of cavernous sinus thrombosis following extraction of teeth in which the patient was treated with penicillin.[4] In view of the paucity of such reports, we believe that we are justified in reporting 2 such instances.

REPORT OF CASES

CASE 1.—C. B., a 20 year old unmarried Lebanese woman, was admitted to the hospital on Dec. 2, 1945 in a semicomatose state. Three days previously she had experienced some pain in the region of her left upper central incisor, which had a synthetic porcelain filling. The pain gradually increased in severity and began to extend to the upper lip and left cheek. On the third day of her illness (day of admission) swelling and redness of the left side of her face were noticed. The patient complained bitterly of pain, headache and chilliness. She soon became irrational and rapidly fell into a semicomatose state. She vomited undigested food several times and urinated involuntarily. The family and past history were not remarkable.

Pertinent physical and laboratory findings on admission were as follows: The patient was an adult fully developed woman, stuporous and restless. The temperature was 102 F. The left central upper incisor was loose, sensitive to percussion, discolored and had a mesial synthetic porcelain filling which was deep enough to have brought about the death of the nerve. The gum around it was swollen and red. The left half of the upper lip, the left cheek and infraorbital area were slightly swollen, red and indurated. The leukocyte count was 14,800 per cubic millimeter, with 92 per cent neutrophils. A catheterized specimen of urine was strongly positive for acetone, showed a trace of albumin and 4 or 5 red blood cells per high power field. The fluid obtained on spinal puncture was essentially normal.

A diagnosis of acute apical abscess, with cellulitis of the left cheek, and acidosis was made.

On December 3 edema of the left eyelids, mild proptosis and chemosis of the left eye developed. Several hours later a mild edema of the right eyelids could be detected. The ocular fundi appeared normal, except for engorgement of the retinal veins on the left side. Meanwhile the patient had been given 400,000 units of

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lin Therapy of Thrombophlebitis of Cavernous Sinus: Case with Recovery, Med. clin., Barcelona **5**:209 (Sept.) 1945. (*n*) Santarelli, A.: Staphylococcic Sepsis with Thrombosis of Cavernous Sinus and Meningitis Cured with Penicillin: Case, Policlinico (sez. prat.) **53**:48 (Jan.) 1946. (*o*) Corcos, A., and Matéri: Bilateral Thrombosis of Cavernous Sinus with Septicemia and Black Vomit: Case with Recovery After Penicillin Therapy, Bull. et mém. Sc. méd. d. hôp. de Paris **62**:88, 1946. (*p*) Boquien, Baron and Rodat: Malignant Staphylococcia of Face with Thrombophlebitis of Cavernous Sinus Treated with Penicillin and Drainage of Cavernous Sinus: Case with Recovery, ibid. **62**:56, 1946.

3. White, J. W.: Penicillin Therapy for Thrombosis of the Cavernous Sinus in a Fourteen Month Old Child, Arch. Otolaryng. **42**:147 (Aug.) 1945.

4. Wiesenfeld, I. H., and Phillips, E.: Thrombophlebitis of a Cavernous Sinus Following Extraction of Teeth, ibid. **40**:497 (Dec.) 1944.

penicillin during the first twenty-four hours and infusions of 5 per cent dextrose in isotonic sodium chloride solution to combat the acidosis. The tooth was opened from the palatal side; drainage was established through the root canal, and about 1 cc. of foul-smelling pus was evacuated. Toward evening the patient became more rational and cooperative. The following morning, December 4, the ocular signs subsided, but some facial swelling remained. The leukocyte count was 10,650 per cubic millimeter, with 66 per cent neutrophils; the urine was free from acetone, and the patient was more lucid mentally. On December 5, the patient looked quite well and expressed the desire to eat. On December 8, the seventh day of her stay in the hospital, administration of penicillin was stopped, her temperature having been normal for three days. She was discharged on December 10 in perfect health and without complaints. She was advised to have proper treatment for her tooth.

During the first and second days 400,000 units of penicillin was given daily, 200,000 units on the third day and 100,000 units daily for the four succeeding days. The penicillin was administered by intramuscular injection and into the root.

Cultures of the blood on December 2 and 4 were sterile. Culture of the pus from the dental canal grew Streptococcus anhemolyticus.

An intraoral roentgenogram of the affected tooth showed great rarefaction at the apex but no evidence of osteomyelitis of the upper jaw.

CASE 2.—H. T., a 20 year old Arab man, previously healthy, started complaining of severe pain in the right upper jaw on May 10, 1946. A dentist who was consulted extracted the upper right first and second bicuspids and the first and third molars in a period of two days, with the operative field uner local anesthesia. According to the patient, there was frank discharge of pus from the alveolar sockets of the extracted teeth. The pain persisted however, and on May 16 the patient had a severe chill followed by high fever (temperature 106 F.). His right cheek and eyelids then became swollen rapidly, so that he was unable to open his right eye. His family physician was consulted and started administration of moderate doses of penicillin and sulfadiazine. On May 18 both eyelids were red and swollen, the right more than the left. The patient became progressively worse, and complained of severe headache and pronounced lassitude. He was admitted to the American University Hospital on May 20.

On admission the patient looked critically ill, and he was irrational much of the time. His temperature was 105 F., the pulse rate 110 and the respiration rate 26. The right eyelids and right cheek were edematous and red, the conjunctiva chemotic and the eyeball proptosed and completely fixed. Examination of the fundus was not possible. The left eyeball showed findings similar to those in the right one but to a lesser extent. On ophthalmoscopic examination the media were clear and the disk outlines greatly blurred, with engorgement of the vessels. There were no hemorrhages or exudates. The right upper gum was red and edematous. Thick yellow pus was draining from the sockets of the extracted teeth. There was slight nuchal rigidity, but all the reflexes were normal.

Daily urinalyses revealed nothing pathologic during the eighteen days of hospitalization. On the patient's admission to the hospital the white blood count was 15,000 per cubic millimeter, with 90 per cent neutrophils. The count gradually fell to 6,900 on discharge. The shift in the differential count paralleled that in the total count.

Repeated cultures of the blood gave negative results. Culture of pus from the dental sockets yielded Streptococcus anhemolyticus. Spinal tap on admission revealed a pressure of 350 mm. of water. The cell count was 350 per cubic millimeter, with 99 per cent neutrophils. There was no growth on culture. Daily

clotting time of the blood remained constant at about seven minutes. Roentgen examination of the skull revealed normal accessory sinuses and no evidence of osteomyelitis of the maxillary bone.

Treatment consisted of 400,000 units of penicillin given daily for the first ten days of the patient's stay in the hospital. Administration was by intramuscular injection. Thereafter 200,000 units was given daily for the following three days and 100,000 units daily on the fourteenth, fifteenth and sixteenth days. The fluid intake was kept at a minimum of 3,000 cc. a day. Daily transfusions of 100 cc. of whole blood together with 100 mg. of heparin were given for the first ten days. The dosage of heparin was apparently inadequate to prolong the clotting time. We were unable to supply the patient with more heparin as all our stock came from the black market and cost fantastic prices. A mouth wash of potassium permanganate 1:10,000 was used as desired.

There was no change in the general condition during the first two days of hospitalization. On the contrary, there was more edema of the eyelids with complete fixation of both eyes. The patient appeared moribund, and we gave the family a bad prognosis. Improvement, however, started on the fourth day and by the seventh day was definitely evident. The temperature fluctuated between 106 and 102 F.

Henceforth there was gradual return of function of both eyes and resolution of the edema until, on June 3, the patient had apparently completely recovered except for a slight residual swelling around the right eye. He was discharged on June 6, and three months later his face looked entirely normal.

COMMENT

In the absence of positive results on culture of the blood or an abnormal condition of the spinal fluid in our first case, the diagnosis of thrombosis of the cavernous sinus is open to criticism. We feel, however, that Eagleton's[5] diagnostic criteria, as cited by the Wolfes[6] and by Conte, are sufficiently fulfilled by this case to warrant the diagnosis of beginning phlebitis (if not thrombophlebitis) of the cavernous sinus. These criteria are: (*a*) a known site of infection; (*b*) blood stream infection as evidenced by chilliness, high fever and toxicity (sterile blood cultures in our case could possibly be attributed to the fact that the specimen of December 2 was taken too early in the course of the disease and that of December 4 was taken after the patient had received 800,000 units of penicillin); (*c*) signs of venous obstruction in the retina, conjunctiva, eyelids and orbits on both sides (although mild, these were definitely present in our patient); (*d*) paresis of the third, fourth and sixth nerves (we could not demonstrate this in our patient

5. Eagleton, W. P.: Cavernous Sinus Thrombophlebitis and Allied Septic and Traumatic Lesions of the Basal Venous Sinuses: A Clinical Study of Blood Stream Infection, New York, The Macmillan Company, 1926.

6. Wolfe, C. T., and Wolfe, W. C.: Thrombosis of the Cavernous Sinus with Recovery, Arch. Otolaryng. **33**:81 (Jan.) 1941.

as she was semicomatose during the first part of her illness); (*e*) and (*f*) treatment was started too early to allow abscess formation in the neighboring soft tissue parts or meningeal irritation to develop. With very little stretch of conscience, however, one could easily attribute the patient's semicomatose state to meningeal irritation.

The principal evidence against the diagnosis of cavernous sinus thrombosis is the outcome of the disease, namely rapid resolution and cure. It must be remembered, however, that administration of penicillin was started very early—in fact, before the diagnosis was made. Furthermore, the offending focus was drained with the least possible amount of trauma to adjacent parts.

Once more our second case illustrates the danger of operating on oral structures in the presence of acute infection. There was no difficulty in making the diagnosis.

The first patient received only penicillin, and there can be no doubt that her recovery was due to that drug. That she would have recovered with surgical drainage alone is unlikely. The second patient was desperately ill, and we had to employ every drug at our disposal—penicillin and sulfadiazine. We therefore are in no position to attribute cure to penicillin alone.

SUMMARY

Two cases of acute cavernous sinus thrombophlebitis originating from acute dental infection and cured with penicillin are presented. Streptococcus anhemolyticus was cultured from the primary foci in both instances. The first patient received 1,400,000 units of penicillin in seven days, second patient, 4,900,000 units of penicillin in sixteen days and 96 Gm. of sulfadiazine in thirteen days. Unfavorable reactions to the drugs did not occur in either case.

A critical review of the diagnosis in our first case is presented.

CIGARET SMOKE IRRITATION

III. The Efficiency of Filters in Reducing Its Intensity

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IN A RECENT publication[1] we described in detail a method for the quantitative evaluation of the irritation which cigaret smoke causes as judged by its edema-producing properties, based on gravimetric determination of the increase of the moisture content of the upper palpebral conjunctiva of a rabbit's eye that has been exposed to cigaret smoke. The method is briefly as follows:

A smoking machine of the type described by Bradford, Harlan and Hanmer,[2] which draws a 35 cc. puff once a minute, is used. Three puffs, as a rule, are directed through a suitable cup placed over the widely opened eye of the morphinized rabbit. When one eye only of each rabbit is exposed, the other serving as a control, we name the technic procedure A. When both eyes of each rabbit are exposed, thereby permitting comparison of two cigarets on the same animal, the technic is called procedure B. In both procedures, after the eye has been exposed to the smoke, a one hour period is allowed for formation of edema. The rabbit is then killed, and the membrane of the upper lid of each eye is excised, weighed, dried in an oven to constant weight and then reweighed. From the wet and dry weights the ratio of moisture to dry weight is calculated, and in the case of procedure A the per cent increase of the water of the exposed membrane over that of the control membrane is determined. In a series of such determinations involving two or more groups of cigarets, the differences in the ratios between groups are evaluated statistically for significance by analysis of variance.

In the present study we have applied these procedures to the evaluation of filtration as a means of reducing cigaret smoke irritants of the edema-producing type.

EXPERIMENTS

It is generally believed that the unsmoked portion of a cigaret acts as a filter to the smoke passing through it, and physicians have long

From the Department of Pharmacology, Medical College of Virginia.

1. Finnegan, J. K.; Fordham, D.; Larson, P. S., and Haag, H. B.: J. Pharmacol. & Exper. Therap. **89**:115, 1947.

2. Bradford, J.; Harlan, W., and Hanmer, H. R.: Indust. & Engin. Chem. (Indust. Ed.) **28**:836, 1936.

requested patients with sensitive throats to take only a few puffs from each cigaret.

To determine the validity of this concept 20 cigarets of one brand were selected on the basis of uniform weight (± 5 per cent) and brought to uniform moisture content (within the range of 11.5 to 12.5 per cent by weight). The right

TABLE 1.—*Efficiency of Various Methods of Filtration Used in Reducing the Edema-Producing Properties of Cigaret Smoke*

Experiment	Type of Observations		Observations	Mean of Ratios* (Moisture: Dry Weight)	Increase in Mean Moisture Content, %	Probability Value†
Part 1	2nd and 3rd puff		20	5.69 (4.31)	32.02	.02
	vs					
	5th and 6th puff		20	6.67 (4.28)	55.84	
	2nd and 3rd puff		20	5.69 (4.31)	32.02	.05
	vs					
	8th and 9th puff		20	6.78 (4.18)	62.20	
	5th and 6th puff		20	6.67 (4.28)	55.84	.77
	vs					
	8th and 9th puff		20	6.78 (4.18)	62.20	
Part 2	King size		50	7.29		.002
	vs					
	ordinary size			7.83		
Part 3	Control cigarets vs the following:		20	6.43 (4.73)	35.94	
	Filter tip A (paper)		20	5.78 (4.81)	20.17	.04
	Filter tip B (cotton)		20	5.57 (4.50)	23.78	.09
	Cartridge filter A‡ (cigaret)	(1)	20	5.04 (4.78)	5.44	.0002
		(20)	20	5.55 (4.75)	16.84	.05
	Cartridge filter B (silica gel crystals)	(1)	20	4.93 (4.57)	7.88	0002
		(20)	20	5.78 (4.68)	23.50	.09
	Cartridge filter C (paper)	(1)	20	5.64 (4.62)	22.08	.05
		(20)	20	6.09 (4.83)	26.09	.26
	Wet tip		20	6.63 (4.61)	43.82	.39
Part 4	Control cigarets		20	7.92		.94
	vs					
	tapped cigarets			7.93		
Part 5	Control cigarets		20	5.49		.35
	vs					
	filter tip A			5.68		

*The value in parentheses is for the control tissue (the membrane of the left eye in the procedure A).

†A probability value of .05 and less is usually held to indicate stastical significance; .01 and less indicates a high degree of significance.

‡In the case of the cartridge filters (1) refers to the first cigaret smoked through the filter and (20) to the twentieth.

eyes (procedure A) of 3 rabbits were then exposed to smoke from each cigaret; one to the second and third puffs, one to the fifth and sixth puffs, and one to the eighth and ninth puffs, the first, fourth and seventh puffs being discarded. In all, three groups of 20 rabbits each were used. The results are expressed in table 1, part 1.

Again, on the basis of unsmoked tobacco acting as a filter to smoke passing through it, the supposition has been that smoke from comparable puff-levels of "king size" cigarets would be less irritating than that from cigarets of ordinary length.

To test this supposition, 100 "king size" (85 mm. in length) cigarets of one brand were selected on the basis of uniform weight, and 50 of these, chosen at random, were cut off with a razor blade to the length of ordinary cigarets (70 mm.). All were then brought to uniform per cent moisture content, and 50 rabbits were exposed to second, third and fourth puffs from each as in procedure B. The results are expressed in table 1, part 2.

For various purposes, presumably including that of reducing cigaret smoke irritation, certain manufacturers have attached "filter tips" composed of various materials other than tobacco to their cigarets. For similar reasons, cigaret holders designed to contain a "cartridge filter" are currently marketed. In addition to such devices, certain smokers feel they can accomplish a similar result by liberally moistening the mouth end of the cigaret with saliva. To test the efficacy of some of these procedures the following experiments were performed:

A stock of uniform weight cigarets of one brand was obtained and brought to uniform moisture content. Twenty of each of two brands of cigarets having attached filter devices were purchased; their filters were removed and sealed without distortion to the ends of an equal number of the stock cigarets. One of these types of filter devices seemed to consist of channelized folds of paper; the other consisted of a small plug of cotton held in place by a paper diaphragm. For convenience these will be referred to as filter tip A and filter tip B respectively. Two of each of three types of cigaret holders designed to contain replaceable cartridge filters were purchased. On each rabbit exposure day, the filter in one of each pair was a fresh one, while the filter in the other of each pair had had 19 cigarets smoked through it, making the experimental one the twentieth. The cigarets used in these tests were likewise taken from the same stock of standardized cigarets. One of the cartridge filters used consisted of a cigaret; the second appeared to consist of crystals of silica gel, and the third, of channelized folds of paper which may have been treated in some fashion. For convenience these will be referred to as cartridge filters A, B and C respectively. Finally, a group of the stock cigarets had their tips moistened with saliva prior to smoking, and these will be referred to as wet tip cigarets.

Procedure A being used, 20 eyes were exposed to cigaret smoke subjected to each of the nine filtration conditions described. In addition, to provide a basis for evaluating the results, 20 control eyes were exposed to the smoke of the stock cigarets. For convenience these cigarets will be referred to as control cigarets. Equal numbers of determinations of each type were made on each exposure day, and the sequence of exposures was systematically rotated. In each exposure the second, third and fourth puffs of smoke were used. The results are expressed in table 1, part 3.

In our description of the method used for evaluating the edema-producing properties of cigaret smoke irritants[1] we demonstrated that smoke from tightly packed cigarets produced significantly less edema than that from loosely packed cigarets. Since some smokers have the

habit of tapping the cigaret prior to smoking it, thereby packing the tobacco somewhat more tightly, it seemed of interest to determine whether or not this lessens the irritating properties of the smoke.

To this end, 40 cigarets of uniform weight were selected, and 20 of these were tapped by dropping each six times through a glass tube, 30 cm. in length, against a hard surface. After being brought to uniform moisture content, the 20 tapped cigarets were then paired randomly against the 20 untapped (control) ones, and their smoke was compared for edema-producing properties by procedure B. The results are expressed in table 1, part 4.

RESULTS

From the probability values expressed in table 1, part 1, it is seen that the edema-producing properties of the second and third puffs from a cigaret are significantly less than those of the fifth and sixth puffs or those of the eighth and ninth puffs. Between the fifth and sixth puffs and the eighth and ninth puffs no significant difference was demonstrated. From this it would appear, as judged by edema-producing irritants, that the thesis that the first few puffs from a cigaret are the least irritating is valid.

The probability value expressed in table 1, part 2, indicates that the first few puffs from a "king size" cigaret contain significantly less edema-producing irritants than comparable puffs from a cigaret of ordinary length but having otherwise identical composition and circumference.

The probability values expressed in table 1, part 3, indicate that the cartridge filters can effect a significant reduction of cigaret smoke irritants of the edema-producing type. However, these same cartridge filters undergo reduction in effectiveness on continued use. In the latter connection it seemed of interest to ascertain if part of the decrease of effectiveness might be due to revolatilization of irritant materials deposited in the filters from the previously smoked cigarets. To determine this, a few rabbits were exposed by procedure A to three puffs of air drawn through filters that had had 19 cigarets smoked through them. The results indicate that revolatilization probably accounts for but a small part of the decrease of efficiency of these filters following continued use. Hence decreased efficiency of filtration would seem to be the major factor.

When compared with cartridge filters A and B under conditions providing optimum efficiency of these filters, the filter tips studied were definitely less effective in reducing cigaret smoke irritation. However, they do have the advantage of being used but once, and under the circumstances of this test they proved to be about as effective as the best of the cartridge filters tried after the latter had filtered the smoke from 19 cigarets. It should be pointed out, however, that in the cigarets

from which these filter tips were taken the tips replaced a corresponding volume of tobacco which, as we have shown, is itself an effective filter. This was brought out by an additional experiment in which filter tips of type A were attached to 20 stock cigarets that had been correspondingly reduced in length and the edema produced by the smoke of these cigarets compared by procedure B with that produced by the smoke of 20 stock cigarets that had not been reduced in length. The

TABLE 2.—*Cross Comparisons of Filters Studied*

Comparison	Probability Value	Comparison	Probability Value
Filter tip A vs:		Cartridge filter A (1) vs:	
Filter tip B	.80	Cartridge filter B (20)	.002
*Cartridge filter A (1)	.03	Cartridge filter C (1)	.003
*Cartridge filter A (20)	.64	Cartridge filter C (20)	.091
*Cartridge filter B (1)	.05	Cartridge filter A (20) vs:	
Cartridge filter B (20)	.72	*Cartridge filter B (1)	.41
Cartridge filter C (1)	.89	Cartridge filter B (20)	.47
Cartridge filter C (20)	.45	Cartridge filter C (1)	.57
Filter tip B vs:		Cartridge filter C (20)	.32
*Cartridge filter A (1)	.02	Cartridge filter B (1) vs:	
*Cartridge filter A (20)	.52	Cartridge filter B (20)	.02
*Cartridge filter B (1)	.04	Cartridge filter C (1)	.14
Cartridge filter B (20)	.93	Cartridge filter C (20)	.01
*Cartridge filter C (1)	.85	Cartridge filter B (20) vs:	
Cartridge filter C (20)	.63	*Cartridge filter C (1)	.82
Cartridge filter A (1) vs:		Cartridge filter C (20)	.67
Cartridge filter A (20)	.27	Cartridge filter C (1) vs:	
Cartridge filter B (1)	.68	Cartridge filter C (20)	.52

*The asterisk indicates that the lesser irritation, if any, is in favor of the filter so designated. In all other cases it is in favor of the filter heading the division.

results expressed in table 1, part 5, show that no significant reduction of edema-producing properties of the smoke occurs when this tip is substituted for an equivalent volume of tobacco.

For those interested in cross comparison of the various cartridge filters and filter tips studied, table 2 has been included.

The probability values expressed in table 1, parts 3 and 4, indicate that neither wetting the tip nor tapping the cigaret (as described on a foregoing page) will significantly reduce the edema-producing properties of the smoke. Tests to determine to what extent the tapped cigarets resist air flow showed that their resistance had been but little affected. Hence filtration would remain essentially unchanged, thus accounting for the difference between these results and those reported earlier[1] for

heavy and light cigarets, between which marked differences of air flow and filtration existed.

COMMENT

From the results that have been obtained it is certain that cigaret smoke irritants of the edema-producing type can be significantly reduced by drawing the smoke past an absorbing surface. When it is deemed necessary to diminish irritation of the throat in patients who desire to persist in smoking, adoption of one or another of the more effective smoking technics described in the foregoing pages should prove of benefit.

It seems equally certain that unless selectivity in removing irritant substances through the use of filters can be achieved without detracting from the satisfaction derived from smoking, attempts to reduce cigaret smoke irritation for the average smoker will have to follow other lines. It is apparent that indiscriminate development of increasingly efficient filters would have as its culmination the development of a filter that passed no smoke at all. It is exceedingly doubtful that the average smoker will ever take kindly to this.

SUMMARY

It has been shown that a significant decrease of the edema-producing irritants present in cigaret smoke can be effected by (1) limiting the number of puffs taken from a cigaret, (2) increasing the length of the cigaret and limiting the number of puffs taken, (3) attaching a filter tip of suitable design to the cigaret, provided the tobacco column of the cigaret is not correspondingly shortened, and (4) using a cigaret holder containing a changeable filter of suitable design. The practicability of applying these procedures is discussed.

Mrs. Sarah Guerry gave technical assistance in the experiment reported.

INCIDENCE OF CONGESTION OF THE LARYNX IN MEN AND WOMEN

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SOME months ago Dr. Harry A. Bray, director of the Ray Brook Sanatorium, asked me to make a survey of the upper air tracts of the patients under his care. While engaged in this task, certain observations were made on the larynx which seemed of sufficient importance to be included in a separate report.

In this study 236 patients suffering from pulmonary tuberculosis and 40 healthy adults were examined. It is important to note that I first examined all the men in one group. After finishing with the male patients, all the women were examined. This gave me an opportunity such as I never had before to compare the appearance of the larynx in a fairly large number of men, taken consecutively, with its appearance in a similar group of women.

The group of males consisted of 119 patients with pulmonary tuberculosis, whose ages varied from 18 to 74. The average age was 36 years.

The group of females comprised 117 patients with pulmonary tuberculosis, the youngest of whom was 16 years and the oldest 59 years of age. The average age of the women was 29 years.

It was necessary to exclude 10 or 12 in each group who gagged excessively and made the laryngeal examination unsatisfactory, as well as several nontuberculous persons, such as patients with mediastinal tumor, dermoid cyst of the lung, acute laryngitis, and other diseases.

For the purposes of this study, it was also necessary to exclude 8 men and 6 women with active or healed laryngeal tuberculosis.

This left 84 men and 91 women on the study of whom the statistics are based.

The first observation made was that 26 men, or 31 per cent, showed a normal larynx; 58, or 69 per cent, had chronic congestion of the larynx, either diffuse, embracing the entire larynx, or circumscribed, with discrete congestion limited to certain specific areas.

Among the males, those with chronic congestion were subdivided as follows (table 1): 30 with diffuse and 28 with discrete congestion.

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The discrete congestion of the men was confined to the true cords in 26 and to the arytenoid area in 2 patients.

In contrast to the men, the women's group included 74 in whom the larynx was normal, i. e., 81 per cent, and only 17, or 19 per cent, with chronic congestion of the larynx.

If one analyzes the chronic congestion in the male and female groups one finds an even more striking variation. For example, the

TABLE 1.—*Patients with Pulmonary Tuberculosis*

	Normal Larynx	Congested Larynx	
84 Men	26, or 31%	58, or 69%	30 diffuse congestion 28 discrete congestion
91 Women	74, or 81%	17, or 19%	5 diffuse congestion 12 discrete congestion

male group shows 30 patients with diffuse congestion of the entire larynx, and 28 with discrete or circumscribed congestion. This distribution is approximately on a 50:50 basis.

It is interesting to note that 16 of the 58 males with chronic laryngeal congestion presented, in addition, either chronic congestion of the pharynx or chronic pharyngitis.

An analysis of the laryngeal congestion among the 17 females reveals diffuse congestion in only 5, compared with 12 with discrete congestion —approximately a 1 to 2 ratio. In these 12 cases of discrete congestion the site was as follows: the posterior commissure or the arytenoids in 10; the aryepiglottic folds in 1; the true cords in 1.

Of the women with chronic congestion, 1 had, in addition, chronic catarrhal pharyngitis, and 1, chronic follicular pharyngitis.

It is only fair to point out that in 2 males the congestion was restricted to the right true cord, a localization often regarded as an early sign of laryngeal tuberculosis. If these 2 patients are excluded, the statistics are not materially affected.

As to the other 26 men with discrete congestion among the 84 men examined it is, to me at least, unreasonable to suggest classifying them as having early laryngeal tuberculosis, instead of simple chronic congestion, because these patients as a whole have no significant laryngeal symptoms. In fact, most of them have no laryngeal symptoms at all. Furthermore, the members of the Ray Brook Sanatorium staff have known of this particular group for a long time. Most of these men are still in the hospital, and there has been no development of ulcer or other evidence pointing to the possibility of a definite tuberculosis lesion of the larynx.

What are the possible etiologic factors responsible for this marked difference in men as contrasted with women?

Apparently the amount of tuberculosis involvement of the lungs was not responsible, for the extent of pulmonary disease was approximately the same in men and women in the three stages (table 2).

The presence of tubercle bacilli in the sputum was for all practical purposes the same in the two groups.

As far as smoking is concerned, our statistics show that 70 per cent of the men smoke, while 53 per cent of the women do (table 3).

As to drinking, I have been informed by members of the Ray Brook Sanatorium staff that it is so infrequent that it may be disregarded.

From the foregoing comment it is seen that the cause or causes responsible for the differences observed in the two sexes are not apparent. A search of the literature has failed to reveal any mention of such differences.

TABLE 2.—*Stage of Disease of Patients with Chronic Congestion of Larynx*

	1st stage	2nd stage	3rd stage
58 men	18	35	5
17 women	5	10	2

TABLE 3.—*Patients with Chronic Congestion Who Smoke*

Men	43 of 58=70%
Women	9 of 17=53%

TABLE 4.—*Healthy Men and Women*

	Normal Larynx	Diffuse Congestion	Discrete Congestion
20 men	4, or 20%	16, or 80%	0
20 women	17, or 85%	0	3, or 15%

It was noted that the incidence and the distribution of chronic congestion of the larynx was approximately the same for patients in the early stages of pulmonary disease as for those in the advanced stages. This observation suggests that the congestion may not be related to the underlying disease of the lungs and that the disparity observed in the incidence may perhaps hold true for healthy persons. To clear up this possibility, I selected from the employees at Ray Brook Sanatorium 20 men and 20 women in approximately the same age group who were known to be free from pulmonary tuberculosis in that the results of roentgenologic examinations of the chest and complete physical examinations were negative.

Among the 20 normal men were 4 with a normal larynx and 16 with diffuse congestion of the entire larynx (table 4).

Of the 20 healthy women, on the other hand, 17 had a normal larynx, while only 3 had congestion of the larynx, which was of the discrete type. This discrete congestion affected both vocal cords in 2

women and the posterior commissure in the third. None of the 20 women had diffuse congestion of the entire larynx.

While a group of 40 healthy persons may seem a comparatively small number on which to base conclusions, the examinations ran along so uniformly that a prolongation of the study seemed unnecessary.

CONCLUSION

The majority of women with uncomplicated pulmonary tuberculosis have a normal larynx (81 per cent in the present study).

The majority of men with the same condition of the lungs have chronic congestion of the larynx (69 per cent in the present study).

The incidence of chronic congestion of the entire larynx, in contradistinction to discrete congestion, was considerably higher in men than in women.

A study of healthy adults shows that the frequency of congestion of the larynx is approximately the same in health as in uncomplicated pulmonary tuberculosis.

In diagnosis the recognition of nonspecific congestion of the larynx is of importance, particularly in the presence of pulmonary tuberculosis.

20 Church Street.

Dr. Mack McConkey made helpful suggestions in furtherance of this study.

AUDITORY NERVE IN MULTIPLE SCLEROSIS

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MULTIPLE sclerosis was recognized as a clinical entity more than a century ago, and a voluminous literature has accumulated on its many and varied characteristics. Every physician is familiar with the effects of this disease on the central nervous system and certain of the cranial nerves. The ocular manifestations, for instance, are well known, and defects in the perimetric fields are of diagnostic importance. So it seems strange, indeed, that no serious attempt has been made to search for similar defects in the hearing range.

A number of isolated instances of deafness in cases of multiple sclerosis have been reported in the German literature. A thorough search leads back to 1856, when Valentiner[1] described involvement of the auditory nerve in 1 case of his series. Two further cases were mentioned by Hirsch[2] and Putzar,[3] although the hearing disturbance in Putzar's case may be explained on the basis of an intercurrent infection of the middle ear.

In 1888, Hess[4] reported some interesting auditory findings in a case of multiple sclerosis which he had observed for more than eight years. He noticed a sudden bilateral deafness, which remained permanent in the right ear, while the hearing in the left ear returned gradually after twenty-four hours. Several years later, Oppenheim[5] stressed that hearing disturbances in multiple sclerosis may appear and disappear.

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1. Valentiner, W.: Ueber die Sklerose des Gehirns und Rückenmarks, Deutsche Klin. **8**:147, 158 and 167, 1856.

2. Hirsch, cited by Engelhardt.[21]

3. Putzar: Ueber einen Fall von multipler Sklerose des Gehirns und Rückenmarks, Deutsches Arch. f. klin. Med. **19**:217-245, 1877.

4. Hess, K.: Ueber einen Fall von multipler Sklerose des Centralnervensystems, Arch. f. Psychiat. **19**:64-87, 1888.

5. Oppenheim, H.: Zur Lehre von der multiplen Sklerose, Berl. klin. Wchnschr. **33**:184-189, 1896.

No further reports were available until the beginning of the century, when Berger[6] reported his observations of 206 cases of multiple sclerosis. He found 20 cases of tinnitus and 2 cases of hearing disturbances in this group. Claude and Egger[7] conducted examinations with tuning forks in multiple sclerosis and noted evidence of cochlear fatigue in 11 of 22 cases. Marburg[8] also observed cases of severe disturbances in hearing with marked changes in intensity.

Beck[9] was the first author to give a detailed description of transitory deafness in multiple sclerosis. He reported 2 cases in 1910 and compared the deafness to "transitory amaurosis" of the eye and coined the term "transitorische Oktavusausschaltung" (transitory occlusion of the eighth nerve) for this condition. Three years later, he[10] reported another case in which multiple sclerosis was associated with total deafness and complete loss of vestibular response and facial palsy on the left side. One week after the occurrence of the hearing disturbance, the patient could hear normal conversation with the left ear and there was hyperirritability of the static apparatus for caloric and rotation tests. Beck added the observations that there were no changes in the spontaneous nystagmus, and the sudden interruption of the nerve was not accompanied by severe vertigo or vomiting, as occurs usually in peripheral conditions of the eighth cranial nerve. He[11] also mentioned the disproportion between objective and subjective disturbances, and referred to the importance of this syndrome in the differential diagnosis of tumor of the cerebellopontile angle.

This differentiation also was stressed by several other authors; namely, Bárány,[12] von Eiselsberg and Ranzi,[13] Fischer[14] and Marburg,[15] after von

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6. Berger, A.: Eine Statistik über zweihundert und sechs Fälle von multipler Sklerose, Jahrb. f. Psychiat. u. Neurol. **25**:168, 1905.

7. Claude, H., and Egger: Quelques symptômes nouveaux de la sclérose en plaques, Rev. neurol. **14**:275-277, 1906.

8. Marburg, O.: Die sogenannte akute multiple Sklerose, Mitt. d. Gesellsch. f. inn. Med. u. Kinderh. **4**:200-201, 1905; Multiple Sklerose, in Lewandowsky, M. H.: Handbuch der Neurologie, Berlin, Julius Springer, 1911, vol. 2, pp. 911-958.

9. Beck, O.: Gehörorgan und multiple Sklerose, Monatschr. f. Ohrenh. **44**: 1161-1172, 1910.

10. Beck, O.: Gehörorgan und multiple Skelerose, Monatschr. f. Ohrenh. **47**: 875-877, 1913.

11. Beck, O.: Ueber transitorische Oktavusausschaltung: Zugleich ein Beitrag zur Differentialdiagnose zwischen Akustikustumor und multiple Sklerose, Wein. med. Wchnschr. **63**:2573-2578, 1913; Monatschr. f. Ohrenh. **48**:283, 1914; Beiderseitige Ertaubung bei multipler Sklerose, ibid. **48**:293, 1914.

12. Bárány, R.: Zur Differentialdiagnose zwischen Acusticus-tumor and multipler Sklerose mit bulbärem Sitz, Monatschr. f. Ohrenh. **47**:693-694, 1913.

13. von Eiselsberg, A. F., and Ranzi, E.: Ueber die chirurgische Behandlung der Hirn-und Rückenmarkstumoren, Arch. f. klin. Chir. **102**:309-468, 1913.

14. Fischer, B.: Der periphere und zentrale Vestibularapparat bei der multiplen Sklerose, Ztschr. f. d. ges. Neurol. u. Psychiat. **76**:42-80, 1922.

Eiselsberg had made a diagnosis of tumor of the cerebellopontile angle and had performed an exploratory operation in a similar case. No tumor was found; Bárány examined the patient postoperatively and found the falling and pointing reactions intact. Postmortem observations confirmed the diagnosis of multiple sclerosis of the bulbar type.

About the same time, Gomperz[16] reported the only case of multiple sclerosis in which the first and primary symptom was an isolated disturbance of the auditory nerve. Observation of this case extended over a period of years and the condition was found to be transitory in one ear and permanent on the other side. Oppenheim[17] and Stern[18] confirmed that the original symptom of multiple sclerosis may rarely be a transitory deafness.

In England, Dundas-Grant[19] reported a case of multiple sclerosis in which unilateral "nerve deafness" occurred. In the same year, 1922, Friesner[20] of New York reported that he had examined 10 patients who had multiple sclerosis, but he did not find any apparent evidence of deafness. Engelhardt[21] reported the remaining 2 cases of deafness associated with multiple sclerosis. In the first case the auditory disturbance varied from complete deafness on the right side and mild interference with hearing on the left side to a moderate decrease in hearing on both sides. The other case, observed by Haike, is of special interest; the decrease in hearing occurred only along the medial portion of the tone scale.

Although von Oettingen[22] examined a series of patients with multiple sclerosis in 1940 and mentioned a variety of labyrinthine disturbances, mostly of the vestibular mechanism, in about 50 per cent of his cases we have been unable to find any record of detailed audiometric studies.

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15. Marburg, O.: Hirntumoren und multiple Sklerose: Ein Beitrag zur Kenntnis der lokalisierten Form der multiplen Sklerose im Gehirn, Deutsche Ztschr. f. Nervenh. **68-69**:27-39, 1921.

16. Gomperz: Erkrankungen des Gehörorgans bei multipler Sklerose, Monatschr. f. Ohrenh. **48**:296, 1914.

17. Oppenheim, H.: Lehrbuch der Nervenkrankheiten, Berlin, S. Karger, 1913, p. 789.

18. Stern, F.: Entzündliche nichteitrige Erkrankungen des Gehirns, in Alexander, G., and Marburg, O.: Handbuch der Neurologie des Ohres, Berlin, Urban & Schwarzenberg, 1929, vol. 2, pp. 1014-1078.

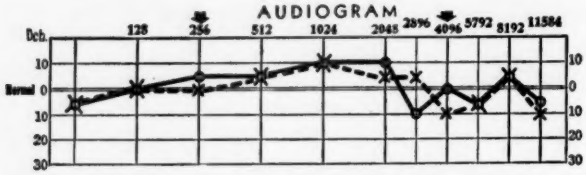
19. Dundas-Grant, J.: Case of Unilateral "Nerve Deafness" in Disseminated Sclerosis, with Immobility of Opposite Vocal Cord, Proc. Roy. Soc. Med. (Sect. Otolaryng.) **15**:42, 1922.

20. Friesner, I.: Symptomatology of the Auditory and Vestibular Apparatus in Multiple Sclerosis, A. Research Nerv. & Ment. Dis., Proc. **2**:95-102, 1922 .

21. Engelhardt, G.: Zur Symptomalogie der Oktavusausschaltung bei multipler Sklerose, Ztschr. f. Hals-, Nasen- u. Ohrenh. **8**:192-205, 1924.

22. von Oettingen, E. N.: Labyrinthäre Störungen bei multipler Sklerose, Nervenarzt **13**:264-268, 1940.

We, therefore, decided to investigate the effect of multiple sclerosis on the auditory nerve in a large series of cases, and we have studied the hearing of 100 patients. In all of these cases, a diagnosis of multiple sclerosis had been made, and the patients had the classic symptoms and signs of the disease. Eight patients were eliminated from further consideration, because they were more than 50 years of age or because they showed some indication of previous disease of the middle ear. This study is based on the remaining 92 cases. In 78, or 85 per cent, of these cases, the patients were less than 40 years of age.



Chare 1.—Normal audiogram of a woman aged 27 years. In all charts, the x line indicates the left ear and the o line the right ear.

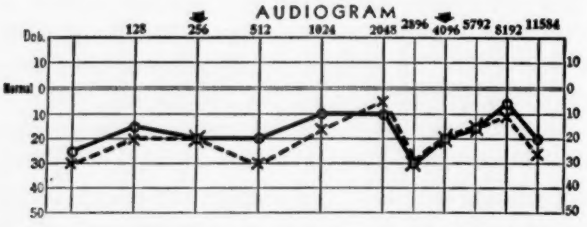


Chart 2.—Audiogram showing a slight loss of hearing along the entire range, bilaterally. The loss was not below the critical level, so this patient could understand normal conversation.

The examination of the auditory nerve was carried out under basal conditions in a soundproof room. A Maico pure-tone audiometer was used.[23]

The results of the investigation will be shown by actual audiograms. Chart 1 shows a normal audiogram.

In a soundproof room, a loss up to 10 decibels, such as was evidenced in this audiogram, is usually considered within the limits of experimental error. For the purpose of this investigation, however, we have included all losses up to 25 decibels as normal, since minor variations are not uncommon in ordinary healthy persons.

In spite of this liberal interpretation of normal limits, only 53, or 57 per cent, of our patients had normal hearing. The remaining 39, or 43

23. This was placed at our disposal by the Maico Company of Minneapolis after it had been specially calibrated for our purpose.

per cent, had some measurable degree of deafness (more than 25 decibels) in one or both ears.

Of these 39 patients with auditory involvement, 6 had a slight loss of hearing along the entire range, as exemplified in chart 2. One should note that the decrease in hearing does not extend beyond the critical level of 30 decibels. The patient, in spite of his definite loss of hearing, still hears normal conversation.

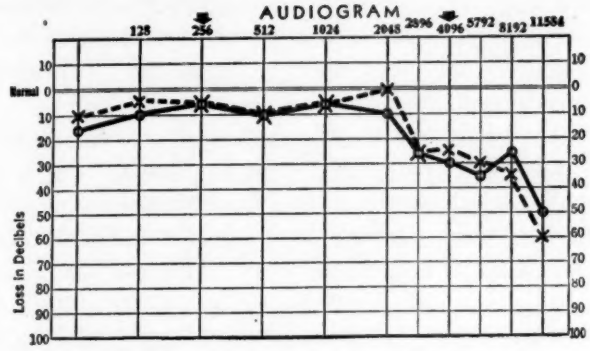


Chart 3.—Audiogram illustrating normal conversational range with loss of hearing for the higher tones, bilaterally.

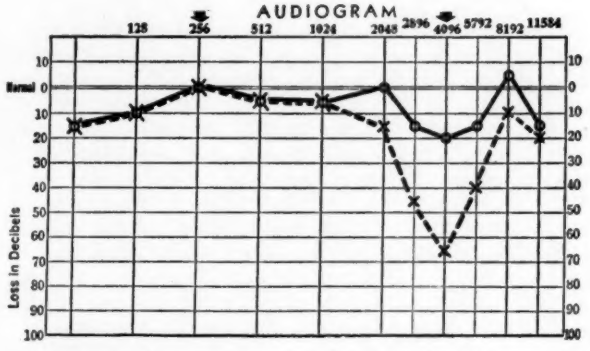


Chart 4.—Audiogram showing a hearing defect in the left ear. The patient had no subjective loss of hearing.

Twenty-four patients had a slight to moderate loss of hearing in the higher frequencies in one or both ears, as shown in chart 3. This type of loss is normally found in older persons, in whom it is known as presbycusis, but in this series we encountered it in young people. Again, the speech range is not affected.

The remaining 9 patients had moderate to severe unilateral field defects up to 70 decibels, as demonstrated in chart 4. In spite of the considerable defect, this type of patient has no subjective deafness, for his hearing in the speech range is normal, and in the higher tones the normal

ear makes up for the loss of hearing in the affected ear. Defects of this kind were noted in different parts of the conversational range, and should explain the findings in the case of Haike, as reported by Engelhardt.

The retention of hearing in the conversational range accounts for the fact that only 12 of our 92 patients complained of decreased hearing. Conversely, it is of interest to note that only 7 of these 12 patients with symptoms of deafness proved to have defective hearing. It is this dissociation of subjective and objective disturbances that is so characteristic of multiple sclerosis. It also has been stressed by other authors, Beck and von Oettingen, and has been observed in all the other phases of this disease as well.

During this investigation no relationship was found between the decrease in hearing and the severity of the disease. This phenomenon again is typical of multiple sclerosis; it is well known that many patients with a mild form of the disease have marked visual difficulties, while others are bedridden and have little or no evidence of ocular involvement.

Patients were also tested for diplacusis. This is a difference in bilateral sound perception, which occasionally occurs in cases of auditory disease. We could find no significant changes in any of our patients. Fourteen of the 92 patients gave a history of tinnitus, but 4 of them had taken quinine previously.

In order to avoid any possible error, we decided to test the hearing of a similar group of normal, healthy persons, picked at random and examined under the same standard conditions. Slight changes of auditory acuity were present in 18 per cent of the subjects, as compared with the varied changes in 43 per cent of the patients with multiple sclerosis.

These findings have also been confirmed pathologically. Schlesinger[24] asserted that he repeatedly found involvement of the auditory nerve in cases of multiple sclerosis in microscopic examination. In 13 consecutive cases of multiple sclerosis, Leidler[25] found that the region of the cochlear and vestibular nuclei was a favorite site for the disease.

The hearing of most of the 92 patients was rechecked at regular intervals to determine whether any changes in hearing occurred during the progress of the disease. Differences up to 25 decibels were recorded, but our observations have not been continued long enough to permit us to correlate these changes definitely with the characteristic remissions and recurrences of multiple sclerosis. However, it was noticed that disturbances of the vestibular division of the eighth cranial nerve provide

24. Schlesinger, H., cited by Bárány, R.: Dauernde Veränderung des spontanen Nystagmus bei Veränderung der Kopflage, Monatschr. f. Ohrenh. **47**:481-483, 1913.

25. Leidler, R.: Ueber die Beziehungen der multiplen Sklerose zum zentralen Vestibularapparat, Monatschr. f. Ohrenh. **51**:249, 1917.

a fairly accurate indication of changes in the general condition of the patient. These vestibular changes will not be considered in detail in this paper because they have been mentioned at length by previous observers (von Oettingen, Stern, Marburg, Friesner, Fischer, Wilson and Bruce[26] and others).

Nystagmus and vertigo are the outstanding symptoms of vestibular involvement. They will be mentioned briefly in order to correct some of the common misconceptions in the literature and because the findings provide a good illustration of the widespread involvement of the central nervous system.

"Dizziness" or "unsteadiness" is undoubtedly one of the most common symptoms in cases of multiple sclerosis; 98 of the 100 patients had had this difficulty at some stage of their illness. However, it should be realized that in most cases the so-called "dizziness" really is an unsteadiness that has a proprioceptive basis, while in other cases it is due to vascular or ocular disturbances. True rotatory vertigo was present in only 18 of the entire group of 100 cases.

Similar observations were made regarding nystagmus, which was at one time considered necessary for diagnosis in cases of multiple sclerosis. Although it is one of the three signs of Charcot's classic triad, neurologic nystagmus was found in only 43 of our cases. However, we encountered 8 cases of one special type of nystagmus, which appears almost pathognomonic of multiple sclerosis, although it is not even mentioned in medical textbooks. This so-called ataxic or dissociated nystagmus consists of conjugate weakness with nystagmus in the outward-turning eye. Harris[27] claimed that it is a pathognomonic sign of multiple sclerosis, and Rucker[28] agreed that in more than 90 per cent of cases it is indicative of multiple sclerosis.

In conclusion, this study clearly indicates that defects of the auditory field, comparable to defects in the perimetric field, occur in cases of multiple sclerosis. The study further demonstrates the destructive effect of multiple sclerosis on the eighth cranial nerve and its associated nuclei. A thorough search of the literature did not reveal any similar studies and observations.

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26. Wilson, S. A. K., and Bruce, A. N.: Neurology, Baltimore, Williams & Wilkins Company, 1940, vol. 1, p. 751.

27. Harris, W.: Ataxic Nystagmus: A Pathognomonic Sign in Disseminated Sclerosis, Brit. J. Ophth. **28**:40-42, 1944.

28. Rucker, C. W.: Personal communication to the authors.

BARTOLOMMEO EUSTACHIO

A Great Medical Genius Whose Chief Masterpiece Remained Hidden for One Hundred and Fifty Years

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THERE are few anatomic structures better known than the eustachian tube. It is well known not only to doctors but also to the ordinary layman, especially if he is one who has, at sometime or other, had to go to the doctor because of a stuffy sensation in the ears resulting from a cold. The doctor has told him that his trouble was due to a swelling of the lining membrane of the eustachian tube, causing obstruction and deafness, and the chances are that sooner or later he has found it necessary to have the tube "blown out" in order to have his deafness relieved.

As I shall later show, Dr. Eustachio is entitled to much greater fame than most historians have seen fit to accord him; but a strict regard for facts compels me to say that he is not fully deserving of the fame of having his name attached to this particular structure.

Its discovery, as it happens, dates back to the very earliest times. It was described by a Greek physician named Alcmaeon, who flourished around 500 B.C., and was one of the first to record observations on anatomy.

Eustachio did describe the eustachian tube in his famous work on the organ of hearing ("De auditus organis," 1564[1]), but he has left us no illustration of it, although in the same work are some excellent drawings of other structures of the ear, which are for the first time described and represented and which therefore better deserve to bear his name. There are other eponyms founded on his name, but the two best known are the eustachian tube and the eustachian valve.

THE EUSTACHIAN TUBE

A canal, about one and a half inches in length, extends from the middle ear cavity inward to open in the upper part of the throat known as the postnasal space. It is lined with a continuation of the pharyngeal mucous membrane, which in this locality is provided with hairlike pro-

1. In Eustachius, B.: Opuscula anatomica, Venice, V. Luchinus, 1564.

cesses known as cilia. The walls are normally in contact, but they are separated and opened by muscles with each act of swallowing.

The function of the tube is to admit air to the middle air cavity as needed to render the air pressure within equal to that without. Eustachio considered the purpose to be to give exit to pus or other secretions originating in the air cavity. In this he was partially right, as it is known that the aforementioned cilia lining the membrane tend to sweep material in the direction of the throat.

THE EUSTACHIAN VALVE

The eustachian valve is a semilunar fold situated at the mouth of the inferior vena cava within the right auricle of the heart and serving as a rudimentary valve for this vein.

The superior vena cava has no valve.

One day in the early part of the eighteenth century the staff of the Vatican library was busy rearranging and cataloging old books and manuscripts.

"Here," said one of the attendants, "are some very old copper plates. What shall we do with them?"

"What is the subject and how old do you think they are?" inquired the librarian.

"They are anatomical drawings, and they must be well over a hundred years old, because they were found among the effects of Dr. Mateo Pino, who died over a hundred years ago. They were donated to the library by Dr. Pini's descendants."

"That is very interesting," replied his chief, "because I know of no other copper plates of anatomical drawings of such early dates. Even the famous plates of Vesalius of about the same date were woodcuts. His Holiness I am sure will be very interested to hear about this, especially as it happens that he was himself, on his mother's side, a descendant of this Dr. Pini."

When the plates were removed and examined, they proved to be the work of Dr. Bartolommeo Eustachio, who was professor of medicine at the Collegio de Sapienza in Rome from 1547 to 1549.

Dr. Eustachio had prepared these plates with infinite skill and industry, but for some reason they were never published during his lifetime. In his will he left them with his favorite pupil and friend, Pier Mateo Pini.

Their existence, however, was known. Dr. Marcello Malpighi had sought them in vain for many years and was greatly disappointed not to be able to locate them.

Their value being recognized, the pope, who was Clement XI, turned them over to his personal physician to do with as he liked. Dr. Lancisi published them with notes and comments in the year 1714.[2] This was a delay of approximately one and a half centuries from the year in which they were prepared by Eustachio, which was said to have been 1562.

Their publication created a great sensation in the medical world, for they were superb delineations, and they revealed an acquaintance with anatomic detail which it was not thought that the author or any one else of that era possessed, and which in some respects had still, it was believed, not been reached. The long delay in their publication was a double tragedy: one affecting the progress of anatomy; one affecting the reputation of the author.

To Andreas Vesalius has been given all the credit as the great anatomist of his day. He has been styled the restorer of anatomy, and the revolutionizing effect of his studies of anatomy, which were based on human instead of animal dissection, has been compared to the revolutionizing effect in this same area of the studies of Copernicus in astronomy.

More than one commentator has remarked that if Eustachio's great work had been published during his lifetime he would undoubtedly have shared honors with Vesalius as one of the restorers of anatomy. He, no less than Vesalius, based his findings on direct personal dissection of the human body, and his anatomic discoveries were of comparable number and importance. Vesalius' reputation rests in a great measure on his superb anatomic figures which appear in his classic work "De humani corporis fabrica."[3]

These were, in accordance with the times, of marked artistic excellence. Vesalius was a man of wealth and employed an outstanding artist, John de Calcar, a pupil of Titian, to make them. It is frequently asserted that Titian himself had a hand in the making of some of them. The human skeleton is shown in various expressive poses—what might well be called studies in animated anatomy. The figures of Eustachio are, in comparison, drab and unlifelike, but they are correct and accurate; though inferior in artistic excellence, they are superior in scientific value.

The great medical historian, Charles Singer, in his "Evolution of Anatomy,"[4] comparing the two, remarked that "the arterial and venous

2. Eustachius, B.: Tabulae anatomicae, quas e tenebris tandem vindicatas et Clementis XI, Pont. Max., munificentia dono acceptas, praefatione, notisque illustravit Jo. Maria Lancisius, Rome, F. Gonzagoe, 1714.

3. Vesalius, A.: Suorum de humani corporis fabrica, librorum epitome, Basel, J. Oporini, 1543.

(Footnotes continued on next page)

system as depicted by Eustachio are at least equal to that of Vesalius, and his representation of the muscular system, especially of the face and the laryngeal apparatus, are in some respects superior."

"In the treatment of the organs of the voice indeed Eustachio easily surpasses his great rival. The glory of the whole collection," he said, referring to the belatedly published plates, "is his truly magnificent drawing of the sympathetic nervous system. We doubt if any better and clearer portrayal of the connections of that system as a whole had been set forth until our own day. It is really a great anatomical figure and is by itself sufficient to place Eustachio in the front rank of anatomists."

In the publications which appeared during his lifetime there are also indications of important anatomic advances and some new discoveries. He is regarded, for example, as the true discoverer of the suprarenal capsules, one of the valves of the heart and of the thoracic duct, anticipating in the last-mentioned instance by a hundred years Jean Pecquet, who is generally given credit for this discovery.

Eustachio also wrote an excellent treatise on the kidneys ("De renum structura") and on the teeth ("De dentibus").[5] His treatise on the teeth, which included a consideration of their blood supply and their development as observed in the embryo, is regarded as the best ever written on the subject up to his time (Garrison[6]).

But what probably is his greatest and most original work is that in connection with the anatomy of the organ of hearing. He made a detailed study of the fine anatomy of both the middle and the internal ear, and although it is true he only described and left no drawing of the tube named after him, he delineated to perfection other parts of the hearing apparatus, including the ossicles and their muscular attachments, and he traced the facial nerve through the walls of the tympanic cavity to its exit at the mastoid foramen.

It is worthy of note, in view of the surgical attention recently centered on this area, that he is considered as the discoverer of the foramen ovalis.

It is rather extraordinary that a man of such outstanding genius has received but slight notice in medical history and that actually little is known about him. He is generally supposed to have been born in the small Italian town San Severino, but the nearest any one came to the

4. Singer, C. J.: The Evolution of Anatomy: A Short History of Anatomical and Physiological Discovery to Harvey; Being the Substance of the Fitzpatrick Lectures Delivered at the Royal College of Physicians of London in the Years of 1923 and 1924, New York, Alfred A. Knopf, 1925.

5. Eustachius, B.: Libellus de dentibus, Venice, V. Luchinus, 1563.

6. Garrison, F. H.: History of Medicine, Philadelphia, W. B. Saunders Company, 1913.

date of his birth was to place it somewhere between 1500 and 1510. The exact date of his death too was for a long time in doubt, as likewise the place of his death and of his burial.

Just before the war, plans were being made to commemorate his life and works by a scientific assembly to be held in his native town, but these plans were probably disrupted by the exigencies of the war, as I have not been able to find any account of its occurrence.

However, probably stimulated by the proposal, Dr. Crivelli, himself a native of San Severino, undertook to find out what he could by a study of old records and state documents. It seems certain that his death occurred in the latter part of August in the year 1577, and that it took place somewhere on the road between Rome and San Severino.

His old friend and patron, Cardinal de Rovere, was very ill, near death, at the latter town, and Dr. Eustachio decided he must go to see him. But he was himself an invalid, being a sufferer from arthritis, and the weather at the time was hot and oppressive. He should never have undertaken the journey, for on the way he became worse and died before reaching the bedside of his dying friend. Dr. Crivelli's investigation led him to believe that the body of Eustachio found a final resting place in the Church of the Apostle in Rome.

Eustachio's father was a physician, a learned man and a member of an old patrician family. There were two sons and four daughters. Both Bartolomeo and his brother Fabrizio took up medicine for their life work, and tradition holds that the father superintended their first years of instruction.

Bartolomeo soon left San Severino to continue his studies in Urbino, which at that time was an important center of learning and of art and culture. He acquired distinction in three separate branches of learning: languages, mathematics and anatomy. He became adept especially in Greek, Hebrew and Arabic, and it was said that he could read with ease the Arabian medical authors in their original language. He acquired a reputation as being also one of the leading mathematicians of the city, and at the same time he was zealously pursuing his favorite study of anatomy. By reason of his exceptional ability, he was accorded a high place in court circles and became physician to the family of the Duke, Guido Ubaldo.

In the year 1549 the Duke's youngest brother, Della Rovere, was designated as cardinal by Pope Paul III. As this required his residence in Rome and as he had come to depend on Dr. Eustachio as his medical adviser, he asked and received consent to take the doctor with him in this capacity. Through the influence of the Cardinal, Eustachio was appointed professor of medicine at the Collegio della Sapienza; and still more important, through the same influence he obtained permission to

perform autopsies on patients who died under his care in the hospitals. This was a remarkable concession, considering the long deep-rooted objection on the part of the church to such practice. The traditional opposition of the church was overcome by Eustachio's convincing argument that postmortem examination of the diseased organs of the patient would be of the utmost benefit in determining the cause of death and that it would afford helpful knowledge for the treatment of others who might be similarly affected. Eustachio thus made a beginning in the great science of clinical pathology. Incidentally, he took advantage of the opportunities thus opened up to extend his knowledge of normal as well as of morbid anatomy.

His position at the university was that of professor of medicine, but he obtained for his special protege, Pier Mateo Pini, who came with him from Urbino, appointment as anatomic dissector. Working together, these two men dissected in the neighborhood of 200 human bodies. Sooner or later opposition was sure to arise. Members of the medical profession, abetted by members of the clergy, waged war against him, some no doubt because of their convictions, others because of jealousy. They charged that Dr. Eustachio was making use of his hospital privileges to indulge his "personal caprices in university instruction."

It is probable that the hostility against him bore fruit, because Eustachio's professorship lasted only twelve years (1549 to 1561), when he resigned for what he called "good and sufficient reasons." It may have been, however, that his bad health had something to do with it, for he was the victim of arthritis, which with time was growing worse instead of better.

The mystery of his failure to publish during his lifetime the atlas embodying his greatest achievement, the preparation of which must have cost much work and money, has never been satisfactorily solved. It has been stated that in his later life he fell into such a state of poverty that he could not afford it. This, however, seems disproved by the discovery of his will, according to which he appears to have had considerable property to dispose of. To his son Ferdinando, a physician, he left a sum of money, but to his pupil Mateo Pini he left his valuable mathematical instruments and his anatomic plates.

Eustachio had taken a prominent part on the side of those who defended Galen and the old orthodox authorities against the audacious attacks of Vesalius. In the beginning, general opinion was with the Galenists, but as testimony accumulated supporting the claims of Vesalius, the anti-Galenists became more assertive and more popular.

Eustachio is said to have taken a modest view of his own merit and achievements. Did he omit publication because of a feeling of personal

discouragement? Or was publication perhaps not obtainable because of unfriendly conditions?

In the pages of medical history the figure of Vesalius looms large. He it was who first broke down traditions of medical teaching, defied the old masters and denounced those who blindly followed in their footsteps. He is acclaimed the great liberator and restorer of anatomic science, and by inference all those who opposed him are negligible persons.

It is likely that many who hold such opinions have been influenced not a little by the grandiose account which Vesalius himself has left of his controversy with his adversaries. He was, without question, a remarkable genius, but he was vain, arrogant, intolerant of criticism and unfair to his critics. He made a reputation by pointing to errors in Galen's anatomy and showing that they were based on animal dissection, and he increased his fame by applying himself with great zeal to the establishment of a correct human anatomy based directly on human dissection.

Eustachio, as we have seen, likewise advanced anatomy by studies made direct on the human body, and his work, although less spectacular, was in some particulars more accurate.

On one occasion he showed, much to Vesalius' discomfort, that the boastful anti-Galenist had fallen into the very kind of error of which he accused Galen. He had represented as a human kidney what was in fact the kidney of a dog.

Eustachio has been ranked with the Galenists, and as a consequence he has lost caste with medical historians, but his defense of Galen and other ancient classical authorities sprang more from sentiment than from conviction.

He was an earnest student of the classics, and his humanistic inclinations were such that he could not bear to have his old masters treated with disdain. He had found much to admire in Hippocrates and Galen, and Rhazes and Albucasis, and felt that they, as others, should be judged according to their lights. He was not one of those fanatic followers who refused to believe that Galen could ever be wrong. He sought only and always the truth, and he welcomed it wherever found.

It is important to recall that Eustachio was more than a mere anatomist. He employed human dissection for a yet higher purpose than to gain therefrom increased knowledge of normal anatomy. He did what Vesalius never presumed to do; he employed dissection with the avowed purpose of discovering the possible cause of the death of the subject, hoping thus to obtain information that might later be useful in curing the sick.

He was the first to introduce such practice as a regular procedure; so that to his merit as an anatomist must be added that of being a pioneer pathologist.

We do not know at what age Eustachio died, because we do not know, except within about ten years, the date of his birth. If it was according to the earliest estimate, he lived to be 74; if according to the latest, he died at the age of 64.

BARTOLOMMEO EUSTACHIO
1500 (?)—1574 (?)
A marble bust by Ercole Rosa at San Severino Marche

Although badly crippled and a great sufferer from arthritis, he was industrious during the later years of life in writing about and publishing the results of his life's work. It seems, however, that he did not intend to publish the greatest of all, because in his will, made in 1570, four

years before his death, he bequeathed his superb collection of copper plates to his pupil Mateo Pini, probably with the idea that they were to be published by the latter some time after his death.

They were resurrected and published after being buried for one hundred and fifty years. They brought to the author a new fame, greater than he had enjoyed during life.

It is to the credit of Eustachio that he rose to such heights of genius at an era when appreciation for science, as for literature and art, were on the decline. His country was under foreign domination; political intrigue and treachery were prevalent, and personal as well as state morals were at a low ebb. His span of life corresponded closely with that of Benvenuto Cellini, who, in his famous biography, has given us a revealing picture of the times.[7]

In the year 1877, just three hundred years after his death, he was honored by having erected in his native town, San Severino, a noble statue produced by a great artist. The accompanying portrait is a photograph of the head of this statue.

But he has not yet received the recognition his genius merits, and though millions daily take his name in vain, there are but few who know anything about his life and work, and still fewer who appreciate his true worth.

7. Cellini, B.: Autobiographical Memoirs, Florence, O. Bacci, 1900.

p_H OF NASAL SECRETION IN SITU IN INFANTS AND IN CHILDREN

The Effect of Hyperventilation and Crying

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HYPERVENTILATION is so common that its importance is frequently overlooked. Increased pulmonary ventilation is due to an increase of either the rate or the depth of respiration or of both. Thus, every person will at some time find himself in a state of hyperventilation as a result of stimulation of the respiratory center due to mental or emotional excitement, or to pain, heat or cold reflexes, or to conditions which increase the demand of the tissues for oxygen, e. g., muscular exercise. In contrast, hyperventilation is also seen in a wide variety of clinical conditions.

Under normal circumstances there is a reservoir of carbon dioxide in the alveoli of the lungs—a phenomenon considered essential to the well-being of the body. Chemical reactions of the body are quickly altered by changes in the concentration of the carbon dioxide in alveolar air. Decrease in the concentration of carbon dioxide in alveolar air may be achieved by several mechanisms. For experimental purposes, forced breathing to increase the depth or the rate of the respiratory excursion will bring this about; so will excessive sighing and yawning. In short, loss of the carbon dioxide in alveolar air produces alkalosis within the body.[1]

Alkalosis may be induced voluntarily by deep and excessively rapid respiration. Alkalosis occasionally occurs during hysterical attacks as a result of hyperventilation (blowing off of carbon dioxide). When hyperventilation takes place in untrained persons who are ascending to high altitudes, where the atmospheric oxygen tension is low, primary carbonic acid (H_2CO_3) deficit and alkalosis frequently follow. Indeed, hyperventilation with resulting incoordination and impairment of judgment represents a condition of considerable importance in aviation. In addition, hyperventilation may occur because of the increased respiratory

1. Best, C. H., and Taylor, N. B.: The Physiological Basis of Medical Practice, ed. 4, Baltimore, Williams & Wilkins Company, 1945, pp. 350 and 361.

rate associated with increased body temperature. This type is prone to occur in inflamnatory conditions involving the respiratory passages, especially pneumonia.[2]

Among neurologic disorders, alkalosis due to hyperventilation has been observed in the lethargic type of acute epidemic encephalitis. In certain patients a slight amount of hyperventilation may precipitate an attack of tetany.[3] Actually, a considerable variety of symptoms occurs in persons suffering from tetany due to hyperventilation. Early symptoms include light headedness, giddiness, a sense of unsteadiness, and numbness and tingling of the toes. More advanced symptoms comprise difficulty in speaking, pressure sensations within the thorax and spasms of the wrists and feet. In cases of unusually severe hyperventilation tetany, laryngeal stridor, generalized convulsions, opisthotonos and unconsciousness may occur.

In by far the largest number of reported cases, hyperventilation falls in the group of psychoneuroses; in these cases anxiety neuroses and hysteria appear to be the most common. However, hyperventilation frequently accompanies rage, sorrow, fatigue, excitement and apprehension. Emotional experiences involving grief, fear, anger and love are associated with respiratory stimulation. The effort of crying seems to be made easier by hyperventilation. Children, thinking tears warranted but finding them not quite spontaneous, have often facilitated crying by taking a few deep breaths.[4]

Recently, attention has been directed by a number of investigators to a relationship between emotional factors, on one hand, and frequency of acute colds and their sequelae and altered nasal function, on the other. Just as emotional changes can cause vasomotor changes in the nasal mucous membrane, so they can transiently convert the hydrogen ion concentration of the nasal secretion from a normal, slightly acid state to an abnormal, alkaline state.[5] These variations, like vasomotor changes, will not take place within the confines of every nose. It is only in susceptible human noses that there will be demonstrable responses to anxiety, fear, worry and fright.

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2. Cantarow, A., and Trumper, M.: Clinical Biochemistry, ed. 3, Philadelphia, W. B. Saunders Company, 1945, p. 283.

3. Harwood, R.: Hyperventilation Tetany, New England J. Med. **218**:602 (April 7) 1938.

4. Carryer, H. M.: The Role of Hyperventilation in Functional Disorders, Proc. Staff Meet., Mayo Clin. **21**:361 (Sept. 18) 1946.

5. Fabricant, N. D.: Effect of Emotions on the Hydrogen Ion Concentration of Nasal Secretion in Situ, with a Comment on the Terminology of Nasal Hydrogen Ion Concentration Measurement, Arch. Otolaryng. **43**:402 (April) 1946.

PRESENT INVESTIGATION

The p_H of nasal secretion that is in situ in the clinically normal nasal passages of infants and children has been found to range from 5.0 to 6.7. This p_H range parallels that of the secretion in clinically normal adult nasal passages, which indicates a slightly acid state.

In the present investigation, the effect of hyperventilation and crying on the hydrogen ion concentration of nasal secretion in situ was observed in a group of 39 infants and children encountered in private practice.

Their ages ranged from 5 months to 13 years. The group included 20 infants 2 years of age or under and 19 children 13 years of age or under; 20 of the 39 subjects were females, and 19 were males. All the infants were nasally and systemically normal; all the children were nasally normal. Two children, however, had petit mal and 1 child ataxic cerebral palsy. Specially constructed silver–silver chloride glass electrodes[5a] were employed in conjunction with the Coleman electrometer. Because of the inherent difficulty of carrying on nasal p_H readings over long periods in the noses of infants and young children, three consecutive readings were taken at half-minute intervals.

Of the 39 subjects under study, 13 children engaged in experimental hyperventilation, while 26 infants and children had their nasal p_H recorded while they were crying. The method employed in experimental hyperventilation was simple: Each child was instructed to blow forty times against a sheet of tissue paper so that it would sway each time in response to the blowing off of carbon dioxide. Nasal p_H readings were taken immediately before the initial act of hyperventilation and immediately after the termination of the hyperventilation series.

In 6 children the readings indicated significant change of nasal p_H after hyperventilation; in 7 children no appreciable variation of nasal p_H was demonstrated. After hyperventilation, the 6 children presented a measurable trend toward nasal alkalosis. In these subjects the differences between the low and high points of nasal p_H prior to and immediately after experimental hyperventilation amounted to p_H 1.0, 0.8, 0.8, 0.6, 1.0 and 1.3.

With 2 of 26 infants and young children who engaged in crying, it was possible to record nasal p_H readings prior to the crying; here, the record indicated that the nasal secretion had been definitely converted from a normal, slightly acid to an alkaline state. In 21 subjects the dominant finding during the act of crying was the establishment of an alkaline state of the nasal secretion, but 3 subjects fell short of nasal alkalosis during crying by a narrow mathematical margin (table).

COMMENT AND SUMMARY

Every person will at some time find himself in a state of hyperventilation. Chemical reactions of the body are quickly altered by

5a. These electrodes were made according to specifications furnished Coleman Instruments, Inc., Maywood, Ill.

Effect of Hyperventilation and Crying on p_H of Nasal Secretion in Situ in 39 Infants and Children

Patient	Age	Sex	Normal Nasal p_H	Nasal p_H After Hyperventilation and While Crying
1. J.P. (petitmal)	4 yr.	F	5.1 5.2 5.2	5.5 5.5 6.1
2. L.B.	4 yr.	M	5.6 5.7 5.8	6.2 6.4 6.3
3. M.K.	14 mo.	M		7.4 7.4 7.3 } while crying
4. J.W.	4½ yr.	M		6.5 6.6 6.6 } while crying
5. E.J. (ataxic cerebral palsy)	4 yr.	F		6.9 7.0 6.9 } while crying
6. V.S.	3½ yr.	M	6.3 6.1 6.4	6.9 6.8 6.8
7. S.R.	13 yr.	M	5.3 5.3 5.5	5.8 5.9 5.5
8. L.K.	2½ yr.	F		7.5 7.5 7.4 } while crying
9. H.C.	9 mo.	M		7.3 6.9 7.1 } while crying
10. J.G.	13 mo.	M	5.9 5.8	7.7 7.7 7.8 } while crying
11. C.J.	11 yr.	M	6.2 6.3 6.3	6.0 6.2 6.0
12. J.P.	9 yr.	F	6.0 6.2 6.2	6.3 6.3 6.3
13. R.C.	6 yr.	M	6.0 6.2 6.2	6.7 6.7 7.0
14. C.P. (petit mal)	13 yr.	F	6.1 6.2 6.3	6.3 6.1 6.1
15. N.L.	2 yr.	F	6.3 6.4 6.3	7.5 7.6 7.6
16. A.R.	5 yr.	F	5.9 6.0 6.2	5.6 5.8 5.7
17. M.J.T.	8½ yr.	F	5.9 6.1 6.1	6.2 6.1 6.1
18. D.J.	2 yr.	F		7.5 7.6 7.6 } while crying
19. J.B.	2 yr.	M		7.2 7.5 7.4 } while crying
20. H.G.	2½ yr.	F		7.7 7.8 7.9 } while crying

Effect of Hyperventilation and Crying on p_H of Nasal Secretion in Situ in 39 Infants and Children (Continued)

Patient	Age	Sex	Normal Nasal p_H	Nasal p_H After Hyperventilation and While Crying
21. D.W.	7 yr.	F	5.4 5.6 5.5	5.4 5.4 5.5
22. B.G.	15 mo.	F		7.0 7.3 7.2 } while crying
23. K.R.	3 yr.	M		6.7 6.8 6.0 } cried; then stopped
24. D.B.	10 mo.	F		7.4 7.5 7.4 } while crying
25. B.F.	5 mo.	M		6.9 7.0 7.1 } while crying
26. B.C.	8 mo.	F		7.5 7.5 7.5 } while crying
27. P.K.	10½ mo.	F		6.6 6.9 6.8 } while crying
28. J.C.	15 mo.	M		7.1 7.3 7.4 } while crying
29. E.M.	2 yr.	F		7.9 7.8 7.7 } while crying
30. C.K.	3 yr.	M		7.4 7.6 7.6 } while crying
31. C.P.	8 mo.	M	6.2 6.2	7.2 7.4 7.4 } while crying
32. B.A.	17 mo.	M		7.5 7.2 7.2 } while crying
33. R.N.	14 mo.	M		6.8 7.0 6.8 } while crying
34. S.G.	14 mo.	F		6.9 7.0 7.2 } while crying
35. D.S.	6½ yr.	F		6.7 6.9 7.1 } while crying
36. P.L.	11 mo.	F		7.1 7.3 7.5 } while crying
37. L.A.R.	14 mo.	M		7.5 7.4 7.3 } while crying
38. C.J.	6½ yr.	F	6.1 6.1 6.0	6.0 5.9 5.9
39. L.S.	2 yr.	M		7.2 7.3 7.3 } while crying

changes in the concentration of the carbon dioxide in alveolar air. Loss of the carbon dioxide of alveolar air produces alkalosis within the body. When hyperventilation takes place in untrained persons ascending to high altitudes, alkalosis freqently follows. Hyperventilation with resulting incoordination and impairment of judgment represents a condition of considerable importance in aviation.[6]

Alkalosis may be induced voluntarily by deep and excessively rapid respiration. Hyperventilation may occur because of the increase of respiratory rate associated with an increase of body temperature. It is prone to happen in inflammatory conditions involving the respiratory passages, especially in pneumonia. Alkalosis due to hyperventilation has been observed in persons suffering from neurologic disorders, anxiety neuroses and hysteria. Hyperventilation frequently accompanies rage, sorrow, fatigue, excitement and apprehension. The effort of crying seems to be made easier by hyperventilation.

The p_H of nasal secretion in situ in the clinically normal nasal passages of infants and children has been found to range within levels (5.0 to 6.7) indicating a slightly acid state of the secretion. In this investigation the effect of hyperventilation and crying on the p_H of nasal secretion in situ was studied in a group of 39 infants and children; 13 children engaged in experimental hyperventilation, while 26 infants and children had their nasal p_H recorded while they were crying. Of the 13 children instructed to hyperventilate, 6 were found to show a measurable trend toward nasal alkalosis, and 7 showed no appreciable variation in nasal state as indicated in p_H. In 23 of 26 infants and young children engaged in crying, the dominant finding was the establishment of an alkaline nasal state.

185 North Wabash Avenue.

6. Hinshaw, H. C.; Rushmer, R. F., and Boothby, W. M.: The Hyperventilation Syndrome and Its Importance in Aviation, J. Aviation Med. **14**:100 (June) 1943.

RHINOPLASTY IN CHILDREN

With a Report of an Operation on a Nine Year Old Boy

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A SURGICAL operation on the nose may be safely undertaken at an early age without in any way impairing the future development of the organ. According to Salinger,[1] a deviated septum or twisted nose in a child should be corrected if it interferes with function, and in this opinion he is supported by Carter,[2] White[3] and others. Cohen[4] and Peer[5] have reported good results for the repair of a dislocated nasal septum in a 4 year old child. A displaced nasal cartilage was reset on the fourteenth postnatal day by Metzenbaum,[6] who called attention not only to the impaired breathing but to the difficulty in nursing. Ersner[7] corrected this condition at birth. A child 2 years and 6 months old was operated on by Colver[8] for bilateral occlusion of the choanae. He removed a portion of the posterior edge of the septum and breathing became normal. At the age of 21 the nose had a normal development and appearance.

EARLY RHINOPLASTY ADVISABLE IN CHILDREN

Early rhinoplasty in children is advisable for the following reasons:

1. *Prevention of Retarded Facial Development.*—"Through a number of careful histological examinations, Fuchs[9] was able to demonstrate

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1. Salinger, S.: Injuries to the Nose in Children: Diagnosis and Treatment, Arch. Otolaryng. **34**:936-951 (Nov.) 1941.

2. Carter, W. W.: Nasal Obstruction in Children Due to Septal Abnormalities: What Shall We Do For Them? Laryngoscope **43**:377-382 (May) 1933.

3. White, F. W.: Submucous Resection of the Nasal Septum in Children, Arch. Otolaryng. **11**:415-425 (April) 1930.

4. Cohen, S.: Plastic Surgery of the Nose, Laryngoscope **51**:363-377 (April) 1941.

5. Peer, L. A.: Contributions to Plastic Surgery During 1944, Arch. Otolaryng. **42**:56-79 (July) 1945.

6. Metzenbaum, M.: Dislocation of the Lower End of the Nasal Septal Cartilage, Arch. Otolaryng. **24**:78-88 (July) 1936.

7. Ersner, M. S.: Nasal Injury in Dystocia, Ann. Otol., Rhin. & Laryng. **53**:552, 560 (Sept.) 1944.

8. Colver, B. N.: Congenital Choanal Atresia: Two Cases of Complete Bilateral Obstruction, Tr. Am. Laryng., Rhin. & Otol. Soc. **43**:431-451, 1937.

that trauma to the septal cartilage in infancy or early childhood, causing even the slightest hardening or thickening of the cartilage, results ultimately in bony deviation as the process of ossification continues and the newly laid down bone follows the plane of the cartilage it supplants."[1] Washburn,[10] at Columbia, also demonstrated in rats that the bony deformity resulting from the removal of the nasal bone on one side caused deviation to that side.

Faulty upper facial growth accompanies hypertrophy of the pharyngeal tonsils and may also be the result of a thickened septum or bulging turbinates, according to Rosenberger.[11] The pattern of upper facial development is already established by the age of 5 years. Defects of growth, therefore, originate in early childhood and persist through life if not corrected at that time.

In the small, stubby nose often seen in young adults the soft tissues, deficient to begin with and never having been stretched by proper bony growth, cannot be distended to the proper size in one operation. Early grafting permits the use of an adequate graft when the face has attained adult proportions.

Displacement of the septum from the vomerian groove, due to nasal injury, results in maladjustment of the upper jaw and a high arched palate with subsequent dental malocclusions.

A thorough readjustment of the septum in children was formerly considered inadvisable on the theory that it was better to await the development of the vomer. However, unless the relation between the septum and the vomer is reestablished at an early age, the growth of the vomer will take place under conditions that encourage distortion and accentuate the difficulty at a later period.

2. *Early Rhinoplasty in Children Is Advisable to Prevent Interference with Nasal Functions.*—(*a*) The sense of smell may be perverted, diminished or completely lost. (*b*) Sinus function may be interfered with as reported by Schüller,[12] who made roentgenograms of the sinuses in cases of turricephaly and found that this configuration of the nasal structure predisposes to diseases of the accessory sinuses. (*c*) Hearing may be impaired by nasal obstruction. Nasal injury, with resultant anterior nasal

9. Fuchs, K.: Zur pathologischen Histologie der inneren Nase, Monatschr. f. Ohrenh. **66**:1077-1097 (Sept.); 1362-1377 (Nov.) 1932.

10. Washburn, S. L.: The Evolution of the Nose, read before the American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, New York, Nov. 14, 1946.

11. Rosenberger, H. C.: Growth and Development of the Naso-Respiratory Area in Childhood, Ann. Otol., Rhin. & Laryng. **43**:495-512 (June) 1934.

12. Schüller, A.: Roentgen Diagnosis of Diseases of the Head, St. Louis, C. V. Mosby Company, 1918.

obstruction, causes excess positive air pressure. Lesions in the nose and nasal sinuses as reported by Fowler[13] frequently lead to deafness — whether it be incipient, intermittent, permanent or progressive. It has been demonstrated that a change of intratympanic pressure of 5 mm. of mercury is sufficient to produce impairment of hearing. Investigations by Ersner[14] showed a 10 to 15 decibel loss in cases of nasal obstruction. Submucous resection does not necessarily improve hearing.

The difference between nose and mouth breathing must be emphasized. Apart from warming, moistening and purifying the air, the nose exercises an important reflex effect on breathing in the sense of deepening respiration and thus leading to better ventilation of the lungs. The pressure exerted by the inspired air on the nasal mucosa represents physiologically adequate stimulation for the nasal trigeminus nerve from which the impulses pass over from the breathing center to the vagus, phrenic and intercostal nerves.

In these nasopulmonary and nasothoracic reflexes lie the most significant function of the nasal mucosa and the most important difference between nose and mouth breathing.

The bad effect of nonphysiologic breathing is known, and the favorable effect of removal of obstruction to free nasal breathing on the development of the child has been confirmed.[11] The explanation of these favorable and unfavorable effects does not rest on some chance hypothesis of the endocrine function of the adenoid tissue but on the obstruction of free nasal function. The most frequent causes of obstructed nasal breathing in children are the adenoid vegetations and the injuries to the nose in early childhood. Nasal obstruction that is not relieved by tonsillectomy and adenoidectomy may be due to a thickened or deviated septum. The attention of the pediatrician should be called to this important problem, and the fact should be emphasized that in very early childhood it is most important to bring about normal free nasal breathing.

In 6 patients with unilateral nasal obstruction, Pieri[15] made pneumographic measurements of both halves of the thorax before and after operations on the septum. Direct connections were demonstrated between ability to expand halves of the thorax and the stenotic side of the nose, and the decreased expansibility returned to normal after operation.

(*d*) Defects of speech are often caused by inability to breathe through the nose. When cleft palates are repaired before the child

13. Fowler, E. P.: Prevention and Management of Deafness, Tr. Am. Laryng., Rhin. & Otol. Soc. **38**:1-7, 1932.

14. Ersner, M. S.: Nasal Injuries and Their Implications, Pennsylvania M. J. **49**:840-844 (May) 1946.

15. Pieri, P. E.: Espansione polmonare in rapporto alla stenosi nasale (ricerche sperimentali): Nota preventiva, Boll. d. mal. d. orecchio, d. gola, d. naso **57**:2-13 (Jan.) 1939; abstracted, Zentralbl. f. Hals-, Nasen- u. Ohrenh. **31**:680, 1938-1939.

learns to talk, there is usually no defect in speech, whereas if they are corrected after the habits of speech are formed, there is great difficulty in overcoming such defects. It seems logical to assume that this applies as well to defects of speech resulting from nasal obstruction.

3. *Early Rhinoplasty in Children Is Advisable in Connection with Social and Psychologic Disturbances.*—Codazzi[16] stressed the social and psychologic importance of correcting the deformities of the nose during high school and college life, that is, between the ages of 13 and 16, when the student is just reaching out for social and cultural values. The beneficial psychologic effect of such corrections on the student's spirits is convincing. With a normal appearance he becomes a socially well integrated personality. A major deviation from the norm in a child may make him the object of unsolicited concern and produce reactions of self-consciousness and feelings of inferiority. The psychic disturbance may be out of all proportion to the actual deformity.

WHAT TYPE OF RHINOPLASTIC PROCEDURE IS ADVISABLE FOR CHILDREN?

The choice of operation for children is extremely important. The correction of nasal obstruction must embrace not only the deflected septum but also the associated deformities of the external nose, which may involve the nasal bones, the frontal process of the superior maxilla and the lesser and greater nasal cartilages.

(*a*) *Treatment of Recent Nasal Fractures.*—Nasal fractures treated at the time of the accident prevent nasal deformities later in life (Wolf).[17]

The failure to recognize and treat septal hematoma may result in abscess formation followed by scarring, saddleback deformity, flattened nasal bridge, excessively thick septum and nasal obstruction.

In recent nasal fractures, if the septum is dislocated, replace it in the vomerian groove. If this cannot be done by simple manipulation, expose it submucously and correct. There is now general agreement as to the treatment of this type of deformity.

(*b*) *Rhinoplastic Procedure in Treatment of Deformities in Children Due to Old Fractures or Poor Development.*—Proper treatment of this class of deformities depends on recognition of the role played by the nasal septum in the normal anatomic structure and functions of the nose.

Many workers in this field have based their treatment on the theory that the support of the nose depends on the nasal septum. In all their

16. Codazzi Aguirre, J. A.: La nariz en el colegio (acompoñado de un film de casos prácticos personales), Arg. de cir. clin. e exper. **6**:194-197 (April-June) 1942.

17. Wolf, G. D.: Rhinoplasty and Its Relation to Rhinology, Tr. Sect. Laryng., Otol. & Rhin., A. M. A., 1941, pp. 81-95F.

operations, after removing as much of the deviation as possible, they left large segments of the septal cartilage in place in order to buttress the nasal dorsum. They believed that if this was not done saddle deformities would develop. Paucity of follow-up reports during the last twenty years makes it difficult to evaluate their method. In my own experience and that of my associates, this technic does not seem to attain the desired result. Surgery based on this theory limits the sphere of the operator.

Fomon[18] believes that the nasal dorsum does not depend for its support on the integrity of the septum, even after its total removal. A large number of operations performed by qualified otolaryngologists in the Fomon Clinic using a technic based on his theory show good results. A group of operators working independently at the Lierle Clinic[19] in Iowa have confirmed these results. The routine septal repair consists of uncovering the nasal dorsum through an intranasal incision, and intranasal exposure, combined with a transfixion of the nasal septum and reconstruction of the nose. This applies to surgical procedures in adults and older children. In a young child, a more conservative procedure has been successfully used. This operation is described in the following report of a case.

REPORT OF A CASE

History.—The patient was a white boy aged 9 years and 6 months. In early childhood he had fallen on his nose, after which he had difficulty in breathing. A brother, 15, and a sister, 2 years and 6 months old, did not have developmental anomalies. With the exception of bronchopneumonia at the age of 3 years and 6 months and removal of tonsils and adenoids at the age of 4, this boy's history was irrelevant. His birth was normal, and there were no birth injuries. There was no history of falls severe enough to produce unconsciousness or bleeding from the nose, throat or ears. He had difficulty in breathing even after removal of tonsils and adenoids. His speech was affected, and he was unable to pronounce certain letters. He became breathless easily after slight exertion and consequently gave up playing with his friends. According to his mother, "He was slow in everything."

When he was 3 years and 6 months old—at which time the nasal deformity and difficulty in breathing were present—an operation was advised against, on the ground that it would disfigure his face. It is hard to see how the nose could have been more disfigured than when first seen by me.

Examination.—Examination disclosed no scars on the face or the head. His general appearance was that of a child with adenoids. He seemed shy. The pupils, round and equal, reacted to light and accommodation. The thyroid gland was not palpable. Reflexes were normal.

The head seemed somewhat large and the distance between the inner canthi wider than usual. Externally, the nasal bones were separated in the midline and

18. Fomon, S.: The Surgery of Injury and Plastic Repair, Baltimore, William Wood & Company, 1939.

19. Hoffman, W.: Lecture delivered in an instructional course at the American Academy of Ophthalmology and Otolaryngology, October 1946, to be published.

the dorsum was flat. The ridges of the ununited nasal bones could easily be felt. The cartilaginous septum rode the floor of the nose, causing marked nasal obstruction and necessitating mouth breathing. The lower end of the septum was S shaped and projected into both nasal chambers, increasing the obstruction. These factors, operating during the developmental period, resulted in the formation of a high palatal arch and a narrow protruding upper jaw causing malocclusion and overriding of the teeth. All other members of the family and all near relatives had normal dental arches.

Although the hearing was somewhat impaired it did not interfere with normal conversation. There was, however, a notable lack of ability to concentrate.

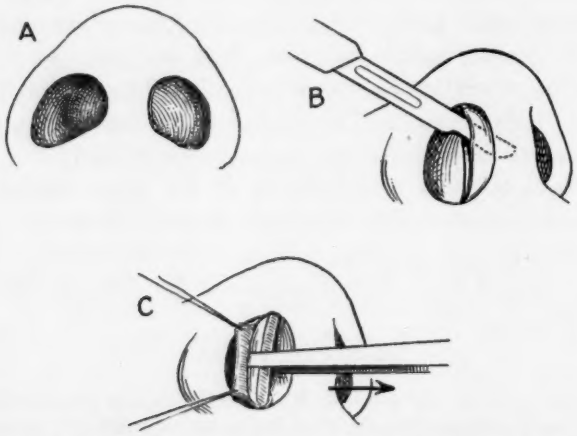

Fig. 1.—The first stage of the operation was performed in June 1945. *A*, complete bilateral nasal obstruction showing S-shaped cartilaginous septum. The septal obstruction begins posteriorly on the right side and rides the floor of the nose to the left, producing an anterior bulge on the left side as well as a posterior convexity on the right, thus resulting in complete obstruction to nasal breathing. Note the flattened nares; the tip of the nose is flattened and depressed.

B, incision through membranous nasal septum. Locate the lower edge of the septum. With a Bard-Parker no. 15 knife an incision is made through the mucosa of one side and a pocket is prepared in the columella with sharp and blunt dissection to receive the autogenous graft. This technic is a modification of the Galloway operation.

In *C*, with sutures for retraction of the mucosa in place, the cartilaginous septum is separated from the mucosa on both sides. A swivel knife is introduced and the cartilaginous septum removed in one piece.

Both nostrils contained a moderate amount of mucopurulent secretion. No polyps were visible. The tonsils had been well removed. There was hypertrophy of the lymphoid tissue in the pharynx.

Roentgenologic examination revealed beginning hyperplastic changes in the maxillary antrums with cloudiness of the other sinuses. Otherwise the bony skull did not show pathologic changes.

Treatment and Course.—After surgical removal of the hypertrophic lymphoid tissue in the nasopharynx, the boy was admitted to the hospital for operation on June 7, 1945. On physical examination, in addition to the foregoing findings, a pulmonic heart murmur was found.

The illustrations[20] indicate the exact procedure and method followed in correcting the nasal deformity in this case.

First Stage of Operation, Repair of Dislocated Nasal Septum: Preoperative medication consisted in the administration of morphine sulfate, 1/10 grain (0.006 Gm.), and scopolamine, 1/250 grain (0.0002 Gm.). Ethyl chloride and ether were administered by open insufflation via the oral route, an endotracheal tube being used. (It is usually practical to use local anesthesia when the child is 7 years or older.)

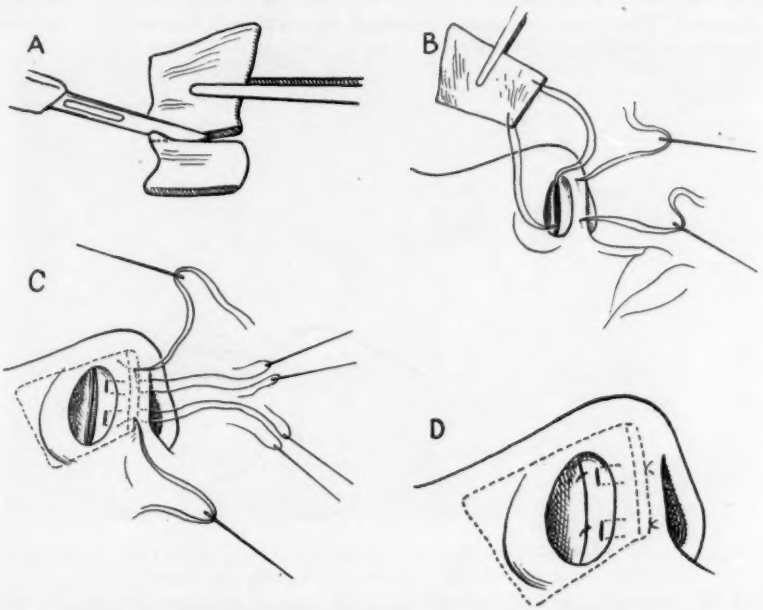

Fig. 2.—*A*, the septal cartilage is trimmed, the bent portion being cut off. The proper size of the cartilage to be replaced is necessary because of contraction. Autogenous or preserved cartilage may be used.

B, double-armed guide sutures attached to autogenous graft after having penetrated the columella. Two pilot sutures are introduced through the original incision and serve as a guide in introducing the graft into the previously prepared pocket in the columella.

C, septal cartilage replaced between the mucosal flaps and guided into the columella bed with pilot sutures. The cartilage grafts are then fixed by two mattress sutures passing through the columella and cartilage and tied on the opposite side. The pilot sutures are then cut and removed.

D, final position of autogenous cartilage graft showing pilot sutures removed and mattress sutures tied. The mucoperichondrium is reattached to the cartilage. In the Metzenbaum operation the caudal end of the septum is sacrificed, resulting in a retracted columella, with poor breathing and deformity.

The entire face and the nasal cavities were scrubbed with medicinal soft soap U.S.P. and water, and then rinsed with sterile water. The face was cleansed with alcohol and ether. The nasal fossae were packed with strips of half-inch (1.27 cm.) sterile gauze to prevent the escape of blood into the nasopharynx. The lower edge

20. The drawings used in illustrating this article were made by Alfred Feinberg.

of the displaced septum was located by means of a rake retractor. With a Bard-Parker knife, no. 15, an incision was made in this area through the mucoperichondrium of one side. A bed was prepared in the columella through the original incision. The mucosa was then elevated from the septum on both sides by sharp and blunt dissection. Silk sutures were passed through the septal mucosa on both sides to aid in retraction. The septal cartilage was cut close to the dorsum with scissors, and a Ballenger swivel knife was introduced through the incision. The entire cartilaginous portion of the septum was removed in one piece.

The bent portion of the cartilaginous septum was cut off and the remainder was trimmed. The trimmed septal cartilage was replaced between the mucosal

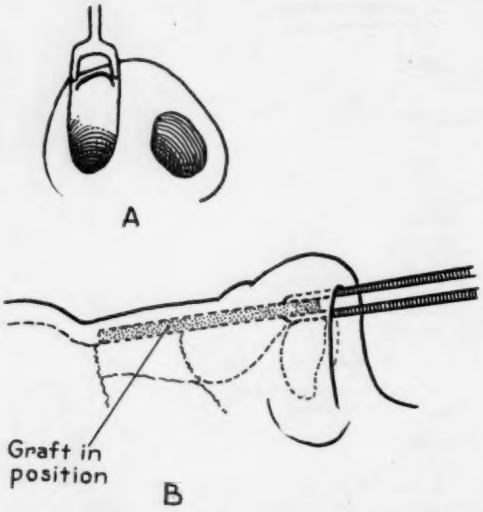

Fig. 3.—The second stage of the operation was performed in February 1946. *A*, curved incision made along the caudal margin of the lower lateral cartilage. The overlying structures are separted in the plane immediately above the perichondrium. Scissors with blunt ends pass from the incision between the cartilaginous and bony framework below, and the skin of the external nose above, thus preparing a bed extending to the root of the nose which will receive the graft of cartilage.

B, graft in position. The adhesive dressing is then applied and a stent mold is fixed in place. The graft serves to keep the skin of the external nose stretched so that later in life this graft can be replaced by a graft of adequate size.

flaps and fixed in place with mattress sutures through the columella. The mucosal incision was then sutured. The nasal chambers were loosely packed with petrolatum gauze.

The petrolatum gauze was removed three days after operation and the sutures on the fourth day.

Second Stage (Feb. 1946), Correction of the Flattened Nasal Dorsum by the Insertion of a Graft of Preserved Cartilage: A transverse incision, one-half inch long, was made in the tip of the nose, just above the nares. By combined blunt and sharp dissection a bed was made between the skin and the bony framework extending to the root of the nose above. The cartilage graft was then introduced through this incision. Finally an external adhesive dressing was applied and a stent mold fixed with adhesive tape.

In the first stage of the operation the septum was replaced, since I believe that a semirigid wall is necessary for the proper interchange of air currents. Only 5 mm. of air pressure is required for the passage of inspired air through the nose to the pharynx. Normal nasal respiration is disturbed by slight changes in the air presure, reported by Lillie.[21]

Fixation of the septum in the columella prevents retraction of the columella such as sometimes occurs in the Metzenbaum operation.

In this type of operation on children the question of the fate of the cartilage is immediately raised. Although Peer[22] has reported the continued growth of

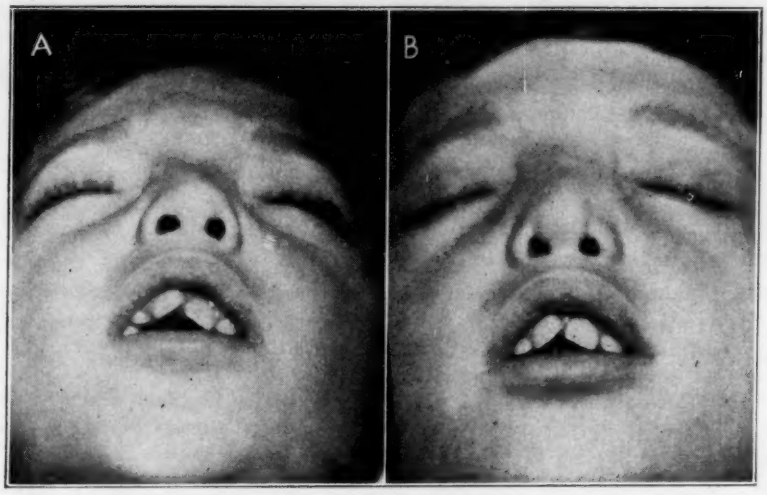

Fig. 4.—*A*, patient before operation in May 1945. The nasal dorsum is deflected to the left. The tip of the nose is depressed, and the nares are distorted and flattened. The palate is highly arched. The central incisors override and there is malocclusion of the teeth. The septum is not visible in this picture.

B, photograph taken in June 1946 following the second stage of the operation as demonstrated in figure 3. The complete operation has been performed. A preserved cartilage graft has been inserted under the skin of the nasal dorsum to keep the skin stretched so that at a later date a large permanent graft may be inserted into the pocket. After the nasal septum had been reconstructed as demonstrated in the illustrations of the first stage of the operation (figs. 1*B* and *C* and 2 *A-D*) the nose resumed its midline position. The tip has been elevated. Breathing is free, as the nasal obstruction has been completely corrected. The teeth do not override as much as before the operation, and the right upper lateral incisor tooth is now in good alinement.

transplanted autogenous cartilage, other observers do not agree. However, it is a fact that transplanted autogenous or preserved cartilage remains alive and is not absorbed.

Follow-Up Observations.—A comparison of the preoperative and postoperative findings one and a half years later, when the boy was 11 years old, showed considerable improvement in several important respects.

21. Lillie, H. M.: Some Practical Considerations of the Physiology of the Upper Respiratory Tract, J. Iowa M. Soc. **13**:403-408 (Oct.) 1923.

22. Peer, L. A.: Experimental Observations on the Growth of Young Human Cartilage Grafts, Plast. & Reconstruct. Surg. **1**:108-112 (July) 1946.

According to his school record, his marks in conduct, reading, speech and physical training improved within six months after the operation on the septum. His breathing is now unobstructed, and he rarely breathes through his mouth. His speech is much improved. Whereas frmerly he was slow in everything, he is now picking up speed. He is able to walk without getting "winded," and he eats faster. His headaches and earaches have disappeared. He is more attentive. Instead of remaining in the house, he now plays with his friends, climbs fences, runs and plays ball. On physical examination, his heart murmur as reported in June 1945 is not present. Since the operation his teeth have become straighter. Orthodontia has been recommended prior to operation, to begin when he had reached the age of 11. Now it is not necessary since the teeth are straightening out by themselves, and they are in better alinement. The boy's facial expression has improved and he looks more intelligent.

Examination of the nose shows that there is now an adequate airway on each side. The nose and septum are in the midline. There is little exudate.

COMMENT

It is my belief, that rhinoplastic procedures in children may be safely undertaken at an early age without in any way impairing the future development of the organ. In this way, faulty facial development may be prevented, normal nasal function established, and psychologic and physiologic disturbances detrimental to the growing child avoided.

880 Fifth Avenue.

Case Reports

TOTAL STENOSIS OF THE ESOPHAGUS DUE TO LYE BURN

SAFA KARATAY, M.D.
ANKARA, TURKEY

THE CASE to be reported is one in which a totally stenosed portion of the esophagus was reopened and dilated, without any complication, under fluoroscopic and retrograde esophagoscopic guidance.

REPORT OF A CASE

M. S., a 29 year old white mine worker accidentally swallowed lye. Gastric lavages were given by a local physician as first aid treatment. The patient was able to take some food during the first days following the accident, but in a short time the passage leading to the stomach was closed by progressive stricture. This condition was diagnosed on the twentieth day, after he was admitted to a local hospital. The patient was then transferred to the Numune Hospital, in Ankara.

The patient was hospitalized for twenty-three days in the ear, nose and throat ward, and peroral dilation was tried, which was not successful. He stated that no bougie could be passed more than 27 cm. from the upper teeth. The patient was moved to the surgical ward for gastrostomy, because it was becoming difficult for him to take even fluids. After the healing of his gastrostomy wound, he was transferred to Gulhane Hospital and was admitted to the ear, nose and throat ward on July 12, 1946.

He was examined on the seventy-fifth day after the accident. His general physical condition was normal. Otolaryngologic examination showed no pathologic change. Roentgenologic examination of the esophagus and fluoroscopic and roentgenologic examinations made after a barium sulfate meal revealed complete stenosis of the esophagus at the level of the fifth and sixth thoracic vertebrae. There was a fairly large clear area above this stricture (fig. 1*A*).

Esophagoscopic Examination.—After induction of local anesthesia, a 7 mm. esophagoscope was introduced into the food passage; it could not be pushed down more than 27 cm., and no definite point could be visualized by which to localize the stenosed passage. There was a fairly large pouch, the lowest part of which was situated 27 cm. from the dental arch of the upper jaw. No attempt was made to force a passage.

Retrograde esophagoscopic examination was performed through the gastrostomy fistula without anesthesia. This revealed a free lumen up to the point of the stricture, which was clearly apparent from this side.

Reopening of the Lumen.—The patient was taken to the fluoroscopic room, and after induction of local anesthesia and administration of morphine, the following procedure was carried out: An esophagoscope was introduced in a retrograde

From the Turkish Army Post-Graduate Medical School and Gulhane Hospital, Ear, Nose and Throat Department; V. B. Ozan, M.D., director.

Fig. 1.—*A*, roentgenogram taken seventy-five days after the accidental swallowing of lye. *B*, bougie passed through the stenosed part of the esophagus into the pharynx.

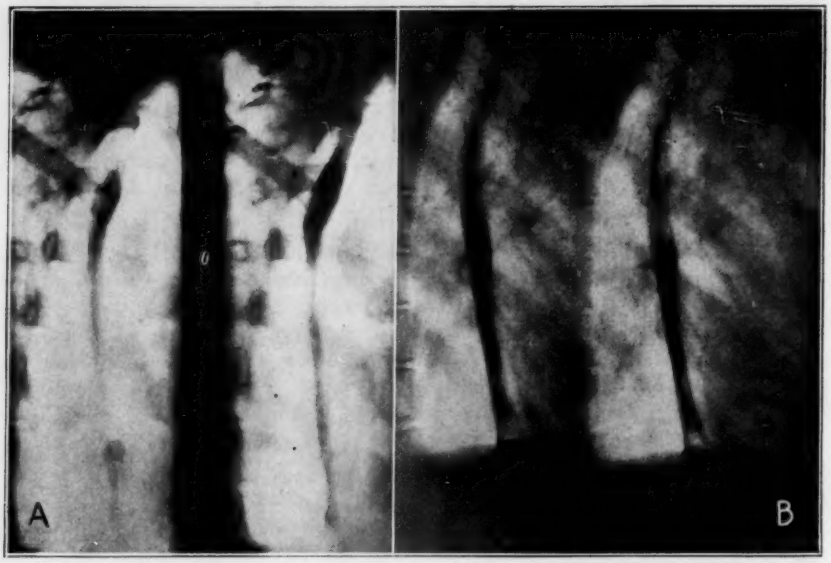

Fig. 2.—*A*, roentgenogram taken at the third month after treatment was begun. *B*, roentgenogram taken at the sixth month.

manner, and when the stricture was reached, the smallest and hardest silk-woven bougie was introduced through the tube. Under fluoroscopic guidance, gradually increasing force was exerted on the bougie. The patient complained of some pain, but it was not severe and soon ceased. The bougie perforated the stenosed part after a few gentle attempts and passed through into the pharynx (fig. 1*B*). A heavy silk thread was looped around the upper end of the bougie and brought out of the gastrostomy fistula. Then the two ends of thread were tied together.

Daily dilations were carried on with bougies of graduated sizes during the first month. At the end of that month there was sufficient lumen to allow solid food to be eaten. Dilations were then done at the rate of one every five days, the bougies gradually increasing in size. The patient was discharged to be followed in the clinic, with a lumen the size of a no. 17 size, olive tip, woven bougie (17 mm.). He could eat everything offered to him, without difficulty at the end of the third month.

The great difficulty in introducing a bougie through the mouth at the beginning was easy to understand after the point of stricture was found, for the lowest point of the diverticulum was situated lower than the beginning of the stenosis. Hence there was a tendency for every instrument to pass into the bottom of that pouch. Any force applied from above might easily have ruptured the esophagus.

SUMMARY

A 29 year old man swallowed lye. The esophagus became completely stenosed at the second and third constrictions. Eighty-eight days later a dissection was successfully performed under monoplane-fluoroscopic and retrograde esophagoscopic guidance. Gradual retrograde dilations were carried on with the aid of a silk thread, which was left in the esophagus after this had been reopened. The treatment was without any complications.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

CONTRIBUTIONS TO PLASTIC SURGERY DURING 1946

LYNDON A. PEER, M.D.
AND
JOHN VAN DUYN, M.D.
NEWARK, N. J.

THREE articles among the numerous contributions on nasal plastic surgery in 1946 are of special importance: Brown and Cannon's review of operations in which composite grafts of skin and cartilage were used in the reconstruction of defects of the ala, Straith's presentation of the Z plastic procedure for elongating the columella, and Dupertuis' original contribution in which he describes how he successfully used composite grafts of skin and fat taken from ear lobes in the reconstruction of defects of the nasal tip and ala.

Increasing evidence was presented indicating that the plastic surgeon should use autogenous cartilage and bone grafts whenever possible in preference to preserved cartilage, which is inferior grafting material. Experimental work with young human cartilage demonstrated growth of this cartilage following transplantation.

Plastic surgeons are avoiding the use of living maternal ear cartilage and maternal rib cartilage for the reconstruction of a complete auricle. Cadaver cartilage is not as popular as it was formerly, and there is a definite preference shown for utilizing the child's own cartilage for structural support of the new ear.

The metals vitallium and tantalum continue to be popular for temporary and permanent support of tissues, but opinion has become divided concerning the indications for their use.

Dr. John Staige Davis, who has been aptly called the father of plastic surgery in the United States, and Dr. Earl Padgett, the inventor of the dermatome, both died during 1946. Each of these men contributed greatly to the general fund of knowledge in plastic surgery.

EDITORIALS ON CURRENT TRENDS IN PLASTIC SURGERY

Supporting Function of the Septal Cartilage.—A number of articles appeared in the 1946 literature challenging the accepted belief that the

nasal septum is an important supporting structure for the lower dorsal line of the nose. The members of our department oppose the point of view expressed in these articles and emphasize that the beam of septal cartilage immediately under the dorsum is necessary for support of the nose.

When the integrity of this beam of cartilage is completely broken, a saddle depression will occur regardless of the relationship between, and the structure of, the lateral and alar cartilages. The deep point of this depression will be located approximately at the connective tissue juncture of the lateral and alar cartilages at some distance above the nasal tip. Naturally, later fibrous tissue contracture in a vertical direction will increase the depth of the saddle, the extent of this increase varying with the relationship between, and the strength of, the lateral and alar cartilages in different patients.

When a saddle depression does not occur immediately after radical removal of the septal cartilage, the explanation is that the beam of cartilage supporting the nasal dorsum was not completely removed. A very narrow strip of septal cartilage concealed from the operator by the lateral and alar cartilages will provide excellent support.

The only indication for the removal of this supporting beam of cartilage is in the correction of a lateral displacement of the lower part of the nose, and this can often be accomplished by partly cutting through the distorted beam of cartilage at various points to reduce its spring and overcorrection of the nose to the side opposite the deformity.

Occasionally a saddle depression will occur while the parts are being manipulated for overcorrection. This depression develops because pressure on the lower end of the cartilage beam spreads one of the partial cross cuts in the cartilage, converting it into a complete cross cut, so that collapse results at this point. The operator must then introduce a septal cartilage graft between the mucous membrane flaps to provide support, or he may insert a graft beneath the skin overlying the depression. The latter is the simpler procedure.

One may remove the displaced lower end of the septal cartilage when it is too thickened and distorted to hinge and replace in a satisfactory manner. After removal of this distorted segment, a straight septal cartilage graft should be substituted not for the purpose of supporting the tip, which remains upright, but to prevent backward retraction of the columella, which results in a "snubbed nose," and to straighten a lateral displacement of the columella.

It is wise to remember that a normal-appearing nose must have the columella at a slightly lower level than the rim of the ala.

It may be definitely stated that the septal cartilage does support the lower dorsal line of the nose. Furthermore, experienced otolaryngologists

know that when this support is removed a saddle depression will result in many cases at the time of the operation.

Choice of Grafting Material.—There is considerable difference of opinion among plastic surgeons regarding the indications for, and use of, various cartilage grafts. One group advocates the use of preserved rib cartilage taken from cadavers, while another employs only living autogenous rib cartilage. The members of this department, particularly Dr. Peer, have consistently emphasized that autogenous cartilage is the "king of buried grafts," and they have demonstrated that it makes little difference whether the graft is costal, septal, alar or aural cartilage. All forms of autogenous cartilage survive after being successfully transplanted as living tissue, which is not absorbed or reduced in size. Recent experimental work indicates that young human autogenous cartilage grafts increase in size or grow, which suggests an additional reason for using autogenous cartilage in infants and young children. Young persons also have a long life expectancy, and consequently they require grafts that will remain throughout life.

Preserved cadaver cartilage is an inferior grafting material, and should be used only when it is not advisable to employ the patient's own cartilage.

In nasal plastic procedures one should utilize septal cartilage for filling saddle depressions whenever it is available in sufficient quantity. Septal bone may be used also, either alone or in conjunction with septal cartilage to increase the bulk of the grafting material. A segment of alar cartilage placed on the outer surface of the composite bundle of grafts will provide a smooth rounded contour for the dorsum of the nose.

The taking of bone from the ilium and cartilage from the patient's chest is indicated only when sufficient septal cartilage and bone are not available to fill a deep saddle depression or to build out a receding chin.

"Nasal tissues for the nose" is an important conception for the otolaryngologist, because its application often simplifies more complicated procedures.

Bifid Nose.—It is surprising that only 13 cases of bifid nose have been reported in the literature, as stated by Weaver and Bellinger in their interesting report of a case. Actually the anomaly occurs more frequently than is generally supposed. The members of our department have seen a total of 14 persons suffering from this deformity. Six were adults, and 8, infants or small children. The less severe form of bifid nose, in which only the alar cartilages are separated (cleft tip), is encountered quite often.

Seven of the 8 children with bifid nose in our series were operated on by two procedures. At the first operation the excess skin overlying

the depressed median groove was excised, the alar and the lateral cartilages were mobilized and sutured together, and the wide columella was adjusted. Dermoid cysts, when present, were removed, and median cleft lip was repaired at the time of the first operation.

In the second operation the bony bridge of the nose was fractured and narrowed, and in 4 cases a segment of the child's rib cartilage was introduced to fill the saddle depression. Narrowing of the broad nose and some degree of elevation for the saddle depression greatly reduce the deformity and make the wide separation of the eyes and the broad head less noticeable.

The noses of all of the patients operated on have appeared to grow with the general growth of the facial structure, and the rib cartilage grafts seem to have increased in size with the nose. One patient, who was operated on at the age of 14 months, has been examined repeatedly over a period of seven years.

Our experience indicates that there is a definite advantage in operating on a bifid nose during infancy or early childhood rather than in waiting until the patient is past the age of puberty. Narrowing of the wide bony bridge with its thick bone structure after puberty is a difficult procedure. Also, because of their appearance, older patients may come to have complexes, which an earlier operation might have obviated.

Three of our patients had bifid nose associated with median cleft lip, 2 had dermoid cysts on the nasal dorsum, and in 1 patient there were associated median cleft lip and meningocele; the latter had gained entrance to the nasal cavity through a dehiscence in the cribriform plate. None of the cases has been reported.

RESULTS OF CLINICAL AND LABORATORY RESEARCH

After a study of the problem of severe burns, which included the following up of 100 cases with 21 deaths, Walker[1] agrees with those who believe a distinction should be drawn between burn toxemia and burn shock. He finds, however, that no quantitative laboratory criteria have been available for the estimation of burn toxemia and proposes that the plasma nonprotein nitrogen be taken as an estimate. According to his observations, it is not always damage of the kidneys which is responsible for the high nonprotein nitrogen present in fatal cases, for, on the one hand, oliguria is not an invariable accompaniment of the toxemic course and, on the other hand, the occasional increases in blood nitrogen are not proportional to the rise in undetermined nitrogen. He believes that the plasma nonprotein nitrogen may also be taken as an index of the severity of burn toxemia.

1. Walker, J., Jr.: A Study of the Azotemia Observed After Severe Burns, Surgery **19**:825 (June) 1946.

This same need for a suitable laboratory test to distinguish true burn toxemia from both burn shock and septic toxemia had also occurred to Van Duyn[2] some time previously. This author found that the ordinary white blood cell count and the differential count could be used as such a test if the examination was made in sufficient detail, and provided the examiner had an understanding of the differentiation of the degenerative and the regenerative type of white blood cell picture. The degenerative white cell picture is brought out by the presence of toxemia, characteristic changes in the original regenerative picture being demonstrable. This, too, is evidence that true toxemia may occur in burns. It is, however, nonspecific, since the same blood changes are found in other toxic conditions, for example, intestinal obstruction. The suggestion is made that blood transfusions and liver extract be used to combat burn toxemia.

In recent years investigation of the causation of internal lesions associated with fatal burns has been complicated by the use of local applications of tannic acid and other escharotics and by the administration of sulfonamide drugs, plasma and intravenous fluids. Dr. Roger D. Baker,[3] of the department of pathology of Duke University School of Medicine, has studied material from ninety-six autopsies in which cutaneous burns or complications of cutaneous burns were shown to be the chief cause of death, but found few lesions in the internal organs. Hepatic necrosis of a high degree occurred not as a direct result of burning but from the effects of infection, tannic acid therapy and cardiac failure.

To combat infection, to stop the foul odor and to prevent adherence of dressings over burns, Ludwig[4] devised a combination solution, which he considers the most effective and the least irritating. The combination used consists of 15 per cent glycerine and 0.5 per cent acetic acid in isotonic solution of sodium chloride (giving a p_H of about 3.8). Next to the wound is placed ordinary 3 inch (7.5 cm.) bandage strips of close-meshed gauze, laid horizontally, followed by application of gauze rolls and "ace bandages" (not wrapped too tightly). The "ace bandages" are removed every eight hours, and the gauze bandages are remoistened with the solution. The first dressing is done at the end of nine or ten days and every three days thereafter.

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2. Van Duyn, J., II: Degenerative White Blood Cell Picture as Indication of Toxemia From Burns, Arch. Surg. **50**:242 (May) 1945.

3. Baker, R. D.: Internal Lesions in Burns with Special Reference to Liver and to Splenic Nodules: Analysis of Ninety-Six Autopsies, Am. J. Path. **2**:717 (July) 1945.

4. Ludwig, F. E.: The Use of Saline Solution, Glycerin, Acetic Acid in Care of Burns, Surgery **19**:486 (April) 1946).

One-half grain (0.03 gm.) of a morphine salt is given before each dressing; no other sedative is required. In this way the demoralizing odor from burn wounds so prevalent in the war areas, where time elapsed between the first treatment in a forward area and the next treatment at a base hospital, could be satisfactorily controlled. Ludwig remarks that the "very minimum of grafting is necessary under this regime, and epithelization appears to be faster than with other methods."

That sulfur-containing compounds should be applied to burns of the eye is a logical step from the fact that they are used on burns of the skin, since both the eye and the skin contain proportionately large amounts of sulfur. Cruthirds[5] has used a sulfhydryl-containing preparation, "hydrosulphosol," in more than 500 cases of burns of the eyes and adjacent areas over a period of five years. He considers his results striking, and believes that one third to one half of the time formerly required to heal such burns was saved. "Hydrosulphosol" is used in the form of a spray, drops or an ointment. Roentgen ray burns of the eye and both acute and chronic, and multiple, corneal ulcers have responded to this form of therapy.

Owens[6] believes that the material placed in immediate contact with the wound in pressure dressings for burned areas deserves more study. Open mesh gauze he considers to be responsible for the presence of pain and bleeding in many instances, because of the tendency for capillaries to grow into it. Grease dressings, on the other hand, interfere with drainage. A satisfactory answer was found in the use of rayon, a material sufficently open to permit drainage of exudates (though it should be kept moist in the presence of infection) and yet so closely woven as to prevent the entrance of capillary buds.

After two years' experience with the use of rayon as a dressing Owens concludes that it is "an ideal material for contact with burns, granulating areas, surface wounds, and donor sites where skin grafts have been removed."

Goldberg[7] found that healing of wounds or ulcers is accelerated by applications of a 15 per cent embryonal tissue emulsion ointment, which stimulates the growth of epithelium and fibroblasts. The tissue extract, obtained from embryos early in pregnancy, is prepared in a castor oil emulsion or petroleum ointment with the addition of 0.3 to 0.5 per cent of "xeroform" (bismuth trigromophenate) or 0.5 to 1 per cent of sulf-

5. Cruthirds, A. E.: Importance of Sulfhydryl in the Treatment of Corneal and X-Ray Burns, Am. J. Surg. **72**:500 (Oct.) 1946.

6. Owens, N.: Rayon, Ideal Surgical Dressing for Surface Wounds, Surgery **19**:482 (April) 1946.

7. Goldberg, D. I.: Stimulation of Wound Healing by Embryonal Tissue, Am. Rev. Soviet Med. **2**:225 (Feb.) 1945.

anilamide. Either preparation is convenient to use and retains active properties for weeks.

Applied to gunshot wounds, burns and decubital or trophic ulcers, the ointment encourages early and extensive granulation, regeneration of connective tissue and rapid epithelization, and diminishes exudates of wounds.

In an extensive experience with war wounds in the Pacific theater, Conway and Coldwater[8] concluded that there is no basis for the legend that wounds heal poorly in the tropics.

The cornified layer of the epidermis is thin and deficient in the inhabitants of the tropics, and the deeper layers of cells are hydropic and immature. There is more intense proliferative activity in the stratum germinativum, and constant sweating leads to maceration and rapid desquamation of the poorly keratinized layers. This moist epithelial detritus acts as a good culture medium. Greasy dressings cannot be tolerated by people in the tropics, for they lead to folliculitis and impetigo.

In a series of 306 grafts of split skin, Conway and Coldwater employed the "open dressing" technic. They held the graft in place not by sutures but by a single layer of coarse gauze laid over the graft and fixed in place by collodion. Immobilization was secured by a plaster cast whenever possible, and a window was cut to provide access to the area. The graft could thus be inspected at will. Saline dressings were applied at frequent intervals, and the gauze anchorage was left in place till the fifth or sixth postoperative day. Immobilization was discontinued on the ninth or the twelfth postoperative day, a pressure dressing was substituted and the patient was allowed to be out of bed. There were 6.7 per cent failures.

A method of administering penicillin which obviates the need for injecting the drug every few hours is reported by Trumper and Thompson.[9] The authors obtained effective blood levels by a technic used for patients with gonorrhea, as follows:

An ice bag of 80 ounce (about 2.5 liter) capacity, filled with crushed ice, was placed about the upper level of one shoulder, fastened by a supporting harness, for a period of two hours, after which chilled penicillin solution (100,000 units in 10 cc. of solution) was slowly injected into the deltoid muscle. The ice bag was then replaced for a period of twelve hours, with refilling as necessary. Cure of the gonorrhea and smears free from gonococci were obtained by the use of this

8. Conway, H., and Coldwater, K. B.: Principles in Reparative Plastic Surgery, Surgery **19**:437 (April) 1946.

9. Trumper, M., and Thompson, G. J.: Prolonging Effects of Penicillin by Chilling, J.A.M.A. **130**:627 (March 9) 1946.

method in 91 per cent of the cases. However, with higher doses, i. e., 150,000 units of penicillin, a 95 per cent cure should be expected.

The results obtained with this method compare favorably with those reported following the use of multiple injections or the use of single injections of penicillin in beeswax and peanut oil.

The chilling method not only reduced to one the number of injections required for treatment of uncomplicated gonorrhea but also rendered the injection painless and made the injection of any other foreign substances unnecessary.

Whereas the attention of bacteriologists and parasitologists has long been engaged with drug resistance or "fastness" (the acquisition of tolerance to chemotherapeutic agents), recently clinicians and epidemiologists have become concerned with the matter. As pointed out by Miller and Bohnhoff,[10] resistant strains of micro-organisms usually susceptible to the sulfonamide compounds have been recognized for some time, and penicillin-resistant strains are now beginning to appear in the clinic and laboratory. The apprehension which might have been caused by the appearance of penicillin-resistant strains is currently being allayed by the introduction of streptomycin.

In the experimental work carried out by Miller and Bohnhoff, repeated cultivation of gonococci and meningococci on mediums containing increasing concentrations of streptomycin enhanced their streptomycin resistance rapidly—within four to six transfers—to such a degree that growth occurred on concentrations of 75,000 units per cubic centimeter, the highest concentration employed. These streptomycin-resistant meningococci remained fully virulent for mice and produced lethal infections with generalized sepsis despite treatment with 15,000 units of streptomycin, the maximum dose tolerated by the animals. Similar infections obtained with the same strains before these had become resistant were regularly cured by doses of from 70 to 100 units of streptomycin.

After testing more than 100 strains of staphylococci, Spink, Hall and Ferris, in 1945, failed to find a single strain not previously exposed to penicillin that was not inhibited by 1 unit of penicillin per cubic centimeter. North and Christie[11] believe that naturally occurring penicillin-resistant staphylococci are rare. However, considerable resistance to penicillin according to the standard sensitivity tests is shown by a large number of strains isolated from patients receiving this drug. Up to this time there was no evidence to indicate whether the resistant strains originated from sensitive organisms already in the wound, or were

10. Miller, C. P., and Bohnhoff, M.: Streptomycin Resistance of Gonococci and Meningococci, J.A.M.A. **130**:485 (Feb. 23) 1946.

11. North, E. A., and Christie, R.: Acquired Resistance of Staphylococci to the Action of Penicillin, M. J. Australia **1**:176 (Feb. 9) 1946.

contaminants with natural resistance, or were strains which had acquired resistance and become disseminated through the wards.

According to recent evidence presented in the literature and our experience, it is likely the penicillin-resistant staphylococci may become a clinical problem in the future.

In all but 5 of 49 consecutive patients with acute secondary parotitis, Altemeier[12] used massive doses of strong solution of iodine U.S.P. alone, as first suggested by Leithauser and Cantor (1935). Penicillin alone or a combination of penicillin and strong solution of iodine U.S.P. was used in these 5 patients. On the whole, the results were considered satisfactory. One patient who failed to respond to treatment with strong solution of iodine U.S.P. responded to the use of penicillin. When abscesses developed, they were drained surgically. Except in 1 instance, abscesses developed only in patients whose parotitis was of three or more days' duration before the start of therapy.

A comparison was made by Rous,[13] of the Rockefeller Institute for Medical Research, between autografts of normal rabbit skin and grafts of skin previously "activated" by chemical irritants.

A rabbit was swabbed on one shaved flank with turpentine-acetone ten days and eight days before the grafts were obtained. The local inflammation was subsiding when the grafts were taken; yet the local skin was half again as thick as normal skin. Microscopically, the graft contained numerous mitotic figures and other evidences of rapid cell division. A safety razor blade on a metal handle with flattened cleats was used to obtain the grafts. Control grafts of normal skin were taken from the opposite flank of the same animal. Three normal grafts and three hyperplastic grafts, 2 cm. square, from each animal were transferred to the overlying exposed lumbar muscles. The grafts were held in place by a paraffin gauze pressure bandage. Three days later each rabbit was killed by an intravenous injection of about 35 cc. of dilute india ink. The three normal grafts merely lay apposed to their beds, whereas the hyperplastic grafts had united and were in most places vascularized, as shown by injections of india ink.

Similar results were obtained when chloroform was used as the preparatory irritant or when the skin was prepared by prolonged application of broth compresses. In all cases grafts were taken with greater ease from the activated area. The activated grafts showed less tendency to contract than normal grafts. In all cases the hyperplastic grafts united with the bed more rapidly and were vascularized sooner than the normal grafts.

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12. Altemeier, W. A.: Acute Secondary Parotitis, Surgery **20**:191 (Aug.) 1946.
13. Rous, P.: Activation of Skin Grafts, J. Exper. Med. **83**:383 (May) 1946.

An acetic acid-glycerin-saline solution preparation which had been successful in the care of burns was applied by Ludwig[14] as a part of his after-care of split skin-grafted areas. Twenty-eight patients were treated, with satisfactory results. When the general condition of the burned patient appeared to be satisfactory, local anesthesia was induced where the grafts were to be obtained, and the grafts were cut with a razor and applied directly to the prepared burned area. It was found unnecessary to cut down the granulations, as the pressure dressings had kept them down. Even severe burns were ready to be grafted by the sixteenth or the eighteenth day.

Fixation of the grafts was obtained by applying the burn dressing over the graft without sutures. The fine mesh gauze was first applied and then the gauze rolls, followed by the "ace" bandages, as in the care of the burned area itself. The dressings were similarly moistened and first reapplied at the end of seven days. Penicillin was given during the first week, but no sulfonamide drug.

Ludwig ascribes the success of the method to the fine mesh gauze applied directly to the graft, the continuous pressure and the type of solution used for moistening. The acidity of the solution seems to aid in epithelization and does not interfere with the growing of the grafts; it is bacteriostatic without inhibiting the healing processes.

McEvitt[15] reports a case in which the use of scarlet red ointment on a patient with bilateral ulcerations of the leg brought about the loss of the grafts. Patch tests confirmed the fact that the patient was sensitive to the dye. The author warns that although this is apparently not a common happening, "such a complication in a burned child with very little available donor area might well prove a tragedy."

Since Dupertuis, in 1941, demonstrated the actual growth of young auricular and costal cartilage grafts in rabbits, Peer[16] has been interested in the application of the principle to man. He has now completed the study of 15 autogenous cartilage grafts in young persons. The cartilages were septal, auricular and costal, some with, and others without, perichondrium. They were left as grafts for from one to two and a quarter years before removal.

Peer's findings indicate growth of the young human cartilage grafts: All of the septal and auricular cartilage grafts showed a demonstrable increase in size at the average rate of about 1/16 inch (15 mm.) in

14. Ludwig, F. E.: Use of Acetic Acid-Glycerin-Saline Solution in Skin Grafting, Surgery **19**:492 (April) 1946.

15. McEvitt, W. G.: Marked Sensitivity to Scarlet Red Ointment, Plast. & Reconstruct. Surg. **1**:193 (Sept.) 1946.

16. Peer, L. A.: Experimental Observations on Growth of Young Human Cartilage Grafts, Plast. & Reconstruct. Surg. **1**:108 (July) 1946.

length in two years. On section the cartilage grafts showed normal-appearing cartilage cells and matrix, with complete absence of invasion or absorption. The cartilage cells themselves can be demonstrated to be in their normal living state by examination of fresh, unfixed sections of the cartilage grafts. Peer concludes that autogenous cartilage grafts should be used in children in order that the growth of the transplanted cartilage may keep pace with the general growth of the region grafted. He also demonstrates that all forms of human autogenous cartilage grafts survive after being successfully transplanted as living cartilage, which is not subject to invasion and absorption. Aural cartilage, septal cartilage, alar cartilage and costal cartilage survive equally well after transplantation.

In an amazing article, Crossman and Allen[17] deny the specific value of plasma for the treatment of patients in shock. They conclude that during the past six years experimentation has revolutionized the treatment of shock by replacing the concept of the former colloid or plasma treatment with that of fluid therapy, chiefly the administration of large volumes of salt solution, and by substituting reduction of temperature for the previous practice of warming. Many forms of trauma can be benefited by the unique power of cold to control simultaneously pain, shock, exudation, infection, necrosis and the formation and absorption of toxins.

In Powers'[18] opinion, patients who stand, walk or sit from the first day after a major operation recover more promptly, safely and comfortably than those who remain quiet in bed for the customary time. Among the few contraindications to early exercise are generalized peritonitis, extreme weakness, serious bleeding during or just after operation, thyroid crisis, coronary thrombosis and pulmonary embolism.

Fever, pulmonary complications other than infarction due to embolus, chemical peritonitis, intraperitoneal abscess, abdominal distention and draining wounds and sinuses need not retard postoperative activity. Thombosis of a deep vein is not a contraindication if the venous channel proximal to the clot has been interrupted promptly.

SKIN GRAFTING

Gay[19] reports the results of applying split skin grafts in 101 cases of large open wounds incurred on the African, Sicilian, Italian and French

17. Crossman, L. W., and Allen, F. M.: Shock and Refrigeration, J.A.M.A. **130**:185 (Jan. 26) 1946.

18. Powers, J. H.: Evaluation of Early Postoperative Activity, Bull. New York Acad. Med. **22**:38 (Jan.) 1946.

19. Gay, E. C.: Skin Dressings in the Treatment of Debrided Wounds, Am. J. Surg. **72**:212 (Aug.) 1946.

fronts of World War II. Most of the wounds were excised, avulsed or saucerized lesions unsuited to secondary closure. In many areas the grafts were placed directly in contact with fascia, muscle belly or exposed peritoneum, and in all there was at least low grade infection. The results showed complete take in 87 per cent and partial take in 3 or 4 per cent more. The value of this procedure in reducing disability and subsequent deformity by clearing up infection and shortening the period of hospitalization is evident. Gay concludes that the optimum time to apply the split graft as a "skin dressing" is five to ten days after injury; that the best type of graft is a thin, split thickness one, and that a program of dressing the wound at forty-eight hour intervals offers the greatest opportunity to combat excessive exudation.

(Comment: The value of such war experiences as these should not be lost sight of in time of peace. Many wounds encountered in civilian practice may be comparable.)

Sheet skin grafts were divided by Padgett[20] into four types: (1) Thiersch (0.008 to 0.10 of an inch or 2 to 25 mm.), (2) split skin (0.012 to 0.016 of an inch or 3 to 4 mm.), (3) three-quarter thickness (0.018 to 0.022 of an inch or 4.5 to 5 mm.) and (4) full thickness (0.030 to 0.038 of an inch, or 7.5 to 9.5 mm.). He then divided the areas to be grafted into two main types: (1) the unhealed lesion, with relatively nonaseptic and granulating areas, and (2) the healed lesion. Under the unhealed lesion are included areas requiring temporary resurfacing as after trauma of more than several hours' duration, the granulating areas of severe burns and other granulating areas in which the granulations are not to be interfered with. On these lesions he used the Thiersch or split skin grafts.

Under the healed lesion are included areas that have cicatricial contractures which when excised or "cross cut" provide an aseptic base. On such a base the thicker grafts may be used. The three-quarter thickness graft, for example, is selected to correct a contracture of the neck or the axilla after all available skin for flap switching has been used; for areas about the elbow, the popliteal space, the perineal region, the groin and the back of the hand; for the replacement of port wine marks; and for the lining of cavities, as eye sockets and artificial vaginas.

Padgett warned that any cutaneous graft is likely not to take on fat or, as a rule, on bone (except for about one-half take on "diploic" bones). He reminded one that uncovered tendons call for a flap and not a free graft of any thickness.

In 1944 J. P. Webster described a method of cementing split grafts to a splint of "pliofilm" while the grafts are being cut by the Padgett

20. Padgett, E. C.: Indications for Determination of Thickness for Split Skin Grafts, Am. J. Surg. **72**:683 (Nov.) 1946.

dermatome. With this thought in mind, Reese[21] developed a new device by which the graft is applied to the dermatome drum mechanically instead of being cemented to it. This device he calls "dermatape." It consists of a single layer of specially woven cloth and two kinds of rubber, one colored red, the other green. The green rubber is specially processed to combine with the skin cement so that a satisfactory graft can be cut, on the one hand, and to absorb the skin cement from the surface of the graft, on the other hand, so that it is free from the graft by the time of the first dressing. Reese states that 2½ inch (1 cm.), ½ inch (125 mm.) and 4 inch (10 cm.) dermatomes have been developed into which have been incorporated a mechanical device for securing and tightening the "dermatape."

A numer of advantages are claimed for the "dermatape" method. Among them are: ease of application by one person; the ability of a graft to hold a normal tension throughout removal and application; need of suturing dispensed with; ease of repeated excisions; a special advantage in pattern grafting, since the graft can be outlined on the red rubber.

Shaw and Payne[22] describe a single-pedicled abdominal flap which is raised and tubed in a single operation instead of the conventional two stages advocated by Gillies. This is possible when the flap is formed on the lower part of the abdomen with the base down so as to include the superficial epigrastric and circumflex iliac veins and accompanying arteries. One stage, single pedicle abdominal tubes may be attached to the wrist and at a later stage carried to the face or to other parts of the body.

The successful use of the Z plastic procedure is illustrated by Stevenson[23] in 2 cases of circular constricting bands of the leg. In the first case, the band was congenital, and after an attempt elsewhere at simple excision, it had recurred and was causing circulatory impairment. In the second case, the band was acquired, being due to scar contracture following a burn.

In discussing the management of contractures of scars following burns, Sutton[24] urges that grafts or flaps never be applied until available adjacent skin has been utilized. He finds that six months to a year after a burn the scar tissue has often stretched and provided a sufficiently

21. Reese, J. A.: Dermatape: A New Method for Management of Split Skin Grafts, Plast. & Reconstruct. Surg. **1**:98 (July) 1946.

22. Shaw, D. T., and Payne, R. L.: One Stage Tubed Abdominal Flaps: Single Pedicle Tubes, Surg., Gynec. & Obst. **83**:205 (Aug.) 1946.

23. Stevenson, T. W.: Release of Circular Constricting Scar by Z Flaps, Plast. & Reconstruct. Surg. **1**:39 (July) 1946.

24. Sutton, L. E.: Reconstruction of the Contracted Axilla, Plast. & Reconstruct. Surg. **1**:43 (July) 1946.

satisfactory circulation to be utilizable in reconstruction procedures. Preference is expressed for interdigited flaps rather than the Z plastic method in most cases of contracted axilla. For the operator to be satisfied with the results, Sutton emphasizes the importance of removing all scar tissue, down to vessels and nerves where necessary, and obtaining complete ranges of motion even if nicking tendons is necessary.

FACE, JAWS, PALATE AND SKULL

The fact is emphasized by Slaughter and Wong[25] that lacerations about the face need special care because a cosmetic as well as functional result must be obtained. A stellate laceration, common over the forehead, is best treated by excision of the fragmented edges, undermining the wound and suturing in a single line. Attention should be given to the lines of Langer. To minimize scar formation, all tension must be removed from the edges of the skin. Adequate undermining and suturing by interrupted buried tension sutures are used. The authors describe special sutures used to achieve these results. The cutaneous sutures are removed in from twenty-four to forty-eight hours, and a firm dressing is applied to aid in splinting the wound. Lacerations of the eyelids should be repaired with great care to prevent notching, cicatricial ectropion and subsequent damage of the eyeball. The conjunctiva and the skin are sutured separately. The tarsus should be brought together accurately. Lacerations about the nose must be repaired with careful attention to symmetry. Lacerations about the tip of the nose should not be sutured heavily, as the blood supply is easily interrupted. Lacerations of the lip call for buried tension sutures and accurate matching of the mucocutaneous line on each side.

Hemiatrophy of the face is an obscure condition, fortunately uncommon since it is of a peculiarly distressing nature. Kiskadden and McGregor[26] discuss the etiologic factors and report a case in which the right side of the face was involved in a young man. The patient was treated surgically by implanting a tantalum plate through an incision over the infraorbital ridge. His appearance was considerably improved. The authors also describe the pathologic changes occurring in the lesion in this case. These were found to consist chiefly of a chronic inflammatory and degenerative process involving mainly the muscle, and apparently still active.

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25. Slaughter, W. B., and Wong, W.: Early Management of Facial Injuries, S. Clin. North America **26**:2 (Feb.) 1946.

26. Kiskadden, W. S., and McGregor, M. W.: Report of a Case of Progressive Facial Hemiatrophy with Pathological Changes and Surgical Treatment, Plast. & Reconstruct. Surg. **1**:187 (Sept.) 1946.

Greeley[27] discusses vascular nevi, which he divides into the capillary and the cavernous type. Each type may be found anywhere and may be of any size. The treatment formerly consisted in applying solid carbon dioxide, radium or roentgen rays, which even now function well in simple lesions; but in the more complicated group excision should be carried out with closure of the defect or application of a properly selected skin graft. In some cases in which the defect is large and closure is elected, this may be done in multiple stages.

Pigmented nevi are brownish-colored lesions varying in shade from *café au lait* to deeper browns. The nevi of darker shades are more likely to take on cancerous changes, whereas the large brownish growths, contrary to popular belief, seem to become cancerous rarely. The problem of their causation has not been solved.

For the sake of safety, expediency and the best cosmetic results, pigmented nevi should be excised, the deep brown nevi being excised widely and the adjacent edges of skin closed. The larger tumors may be removed by excision and closure, performed either in single or in multiple stages, or by the use of a properly selected skin graft.

(Comment: Most angiomas do not grow after birth. The vascular network within the dermis of the affected skin is filled with venous blood or with arterial blood, which gives a bluish or a light red color to the area. When the affected skin is removed and a cutaneous graft placed over the defect, the severed vessels in the subcutanous tissues grow up into the transplanted skin in an orderly manner and do not usually produce a new disorderly and excessive vascular network.)

De Kleine[28] believes that even small scars can be a source of great unhappiness and of serious economic or social frustration. For most conspicuous scars surgical repair offers the greatest hope of improvement. Plastic suturing of facial wounds depends primarily on the use of buried and subcuticular sutures. Ordinary surface sutures may yield equally accurate apposition, but such approximation cannot be maintained for a sufficient length of time without risk of creating disfiguring stitch marks.

The Z incision, Davis[29] tells one, was first used by Denonvilliers in 1856 for the relief of an ectropion of the outer third of an eyelid. The ideal case in which to use the Z incision, with transposition of the triangular flaps thus formed, is that in which the skin is of normal texture

27. Greeley, P.: Plastic Correction of Superficial Vascular and Pigmented Nevi, Surgery **19**:467 (Aug.) 1946.

28. De Kleine, E. H.: Plastic Repair of Facial Scars, Am. J. Clin. Med. **53**:55 (March) 1946.

29. Davis, J. S.: Present Evaluation of the Merits of Z-Plastic Operation, Plast. & Reconstruct. Surg. **1**:26 (July) 1946.

and a web exists. Such conditions, which are usually found in congenital deformities, are comparatively rare, however, and it is in cases of scar contracture following extensive burn or trauma that the Z plastic operation finds its widest use.

Davis calls attention to another field of use less well known, and that is in the obliteration of congenital grooves and such acquired "pucker strings" as may occur around the mouth, following burns. These deformities are, in reality, merely another type of web.

The Z incisions may be made either singularly or in multiple, the latter modification having been first described by Morestin in 1914. The multiple Z's may be used either in a continuous or an interrupted series, and, if interrupted, may be reversed where indicated. If enough relaxation is not obtained by one operation, another may be subsequently performed and the relaxation increased. Davis believes that six months should be allowed to lapse between operations to permit the scar to mature fully and soften.

In regard to the operation itself, the 60 degree angle between the central line and the arm lines of the Z has been found to be the most satisfactory, but angles between 60 and 20 degrees can be used, depending on the condition of the scar and surrounding skin. Davis cautions that the flaps should be handled with small sharp hooks. Massage is started three weeks after the operation and is continued for several months.

In a fully illustrated article Ferris Smith[30] again emphasizes the value of the principle of multiple excision and the varied uses of Z plastics and flaps of normal tissue taken from the vicinity in the correction of scars and blemishes, particularly those of the face. A combination of multiple excision and use of Z plastics is employed in a special way, the purpose being to prevent distorting pull on normal features, such as the eyes and the mouth. In carrying out this combined procedure the author first makes use of the Z plastic method, transferring pathologic tissue from an area where multiple excision would cause distortions to an area where it can be performed without the undesirable effect.

Smith states that the size and the distribution of the lesions should determine the location of the incisions. Incisions are used which, after undercutting, permit the maximum advancement of normal surrounding skin without distortion of the lids, the nose and other features. The article contains illustrations of lesions of the face, such as scars following burns, seborrheic keratosis, hairy moles, pigmented nevi and hemangiomas.

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30. Smith, F.: Multiple Excision and Z Plastics in Surface Reconstruction, Plast. & Reconstruct. Surg. 1:170 (Sept.) 1946.

The results in facial paralysis after the use of transplanted nerves, facial strips and muscle flaps are discussed briefly by Adams.[31] He concludes that substitution of muscle offers the best results when nerve regeneration is hopeless, and is a worth while procedure where nerve re-

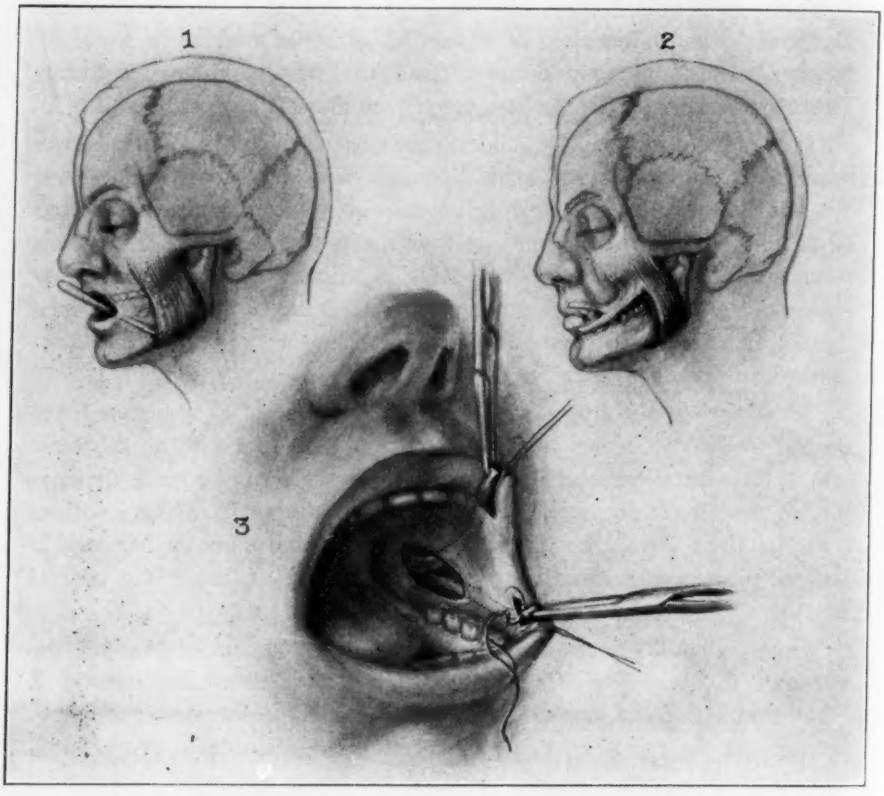

Fig. 1.—Transplanting the masseter muscle to the region about the angle of the mouth according to Adams[31]: (*1*) The masseter muscle is freed from its insertion along the lower border of the mandible through an incision of the buccal mucosa; (*2*) the masseter muscle flap is divided at its distal end and swung anteriorly to the region about the mouth; (*3*) the muscle flap is being threaded through the formed tunnel beneath the mucous membrane of the mouth into the body of the orbicularis oris muscle of the upper and lower lips. The ends of the flaps are sutured as near the midline of the lips as possible. A third suture is placed at the lateral border of the orbicularis oris muscle where this muscle joins with the risorius muscle to bring out the nasolabial expression line.

generation might take place at a later date. The function of transplanted muscle improves as the patient reeducates the muscle and its tone increases, while fascial strips, though they give a better primary result, tend to relax, with return of sagging in the affected area.

31. Adams, W. M.: The Use of the Masseter, Temporalis and Frontalis Muscles in the Correction of Facial Paralysis, Plast. & Reconstruct. Surg. **1**:216 (Sept.) 1946.

Adams believes that the substitution of more than one muscle is necessary to compensate for the loss of function of the eleven major and nine minor muscles that are involved in paralysis of the facial nerve. The masseter muscle is used in the region about the mouth, the tempo-

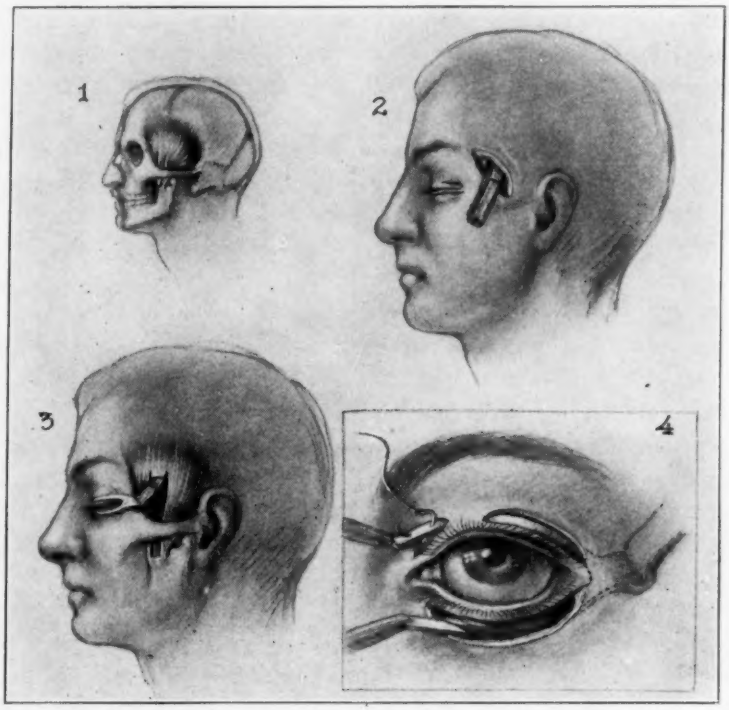

Fig. 2.—Transplanting a flap of the temporalis muscle to the eyelids by the method of Adams[31]: (*1*) The location and the amount of temporalis muscle used to form a flap are shown; (*2*) the freed muscle flap, with the overlying fascia intact, is seen; (*3*) the overlying fascia is reflected down from the body of the muscle to give the length needed to reach the inner canthal region and is divided to give a strip for both the upper and the lower eyelid; (*4*) the flaps are shown threaded through the eyelids and the ends are sutured in the inner canthal region.

ralis is used to aid in restoring and giving support to the eyelids, and the frontalis from the sound side is used to "reanimate" the paralyzed eyebrow. The technic is described and illustrated (figs. 1, 2 and 3). Two cases are presented in detail and illustrated.

Defects of the nose, the ear and the cheek have been filled in by Ivy[32] by means of pedicle tube flaps made from the lower part of the neck. The incisions are horizontal, leaving an inconspicuous scar somewhat like that seen after thyroidectomy. The tubes may be bridged in the

32. **Ivy, R. H.: Repair of Facial Defects by Low-Neck Pedicle Flaps, Plast. & Reconstruct. Surg. 1:119 (Sept.) 1946.**

middle to provide added length. The method is relatively free from discomfort, requiring little or no restriction of motion between stages.

May[33] believes that the main disadvantage of the Dieffenbach operation for the closure of large defects of the lower lip and chin is the

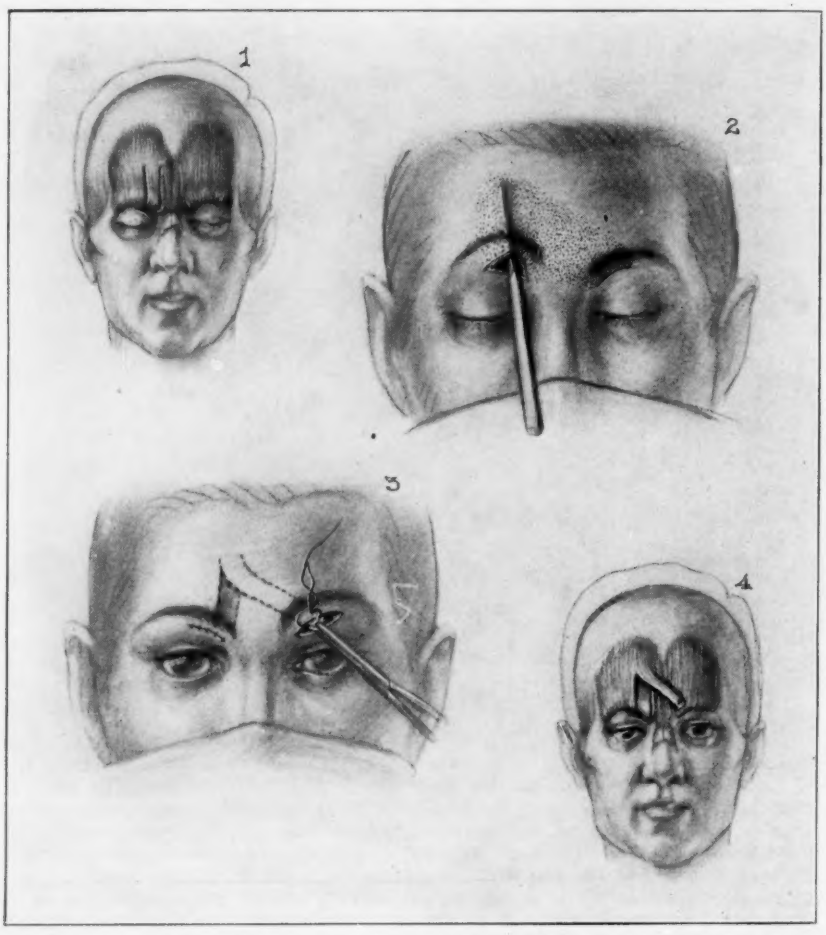

Fig. 3.—Transplanting a frontalis muscle flap to the region of the eyebrow on the opposite side by the method of Adams:[31] (*1*) Two small incisions have been made at the inner border of the right eyebrow just below the hair line; (*2*) the skin of the central portion of the forehead is being undermined at the donor site of the flap; (*3*) the flap is swung over to its new location; (*4*) the point of fixation of the distal end of the flap is shown.

creation of the secondary defect in front of the masseter muscle which must be allowed to granulate in. He overcomes this disadvantage by transplanting a flap of the masseter muscle into the defect.

33. May, H.: Modified Dieffenbach Operation for Closure of Large Defects of Lower Lip and Chin, Plast. & Reconstruct. Surg. **1**:196 (Sept.) 1946.

The advantages of this modified Dieffenbach operation, May says, are: excision of the diseased part and closure of the defect in one sitting; replacement of the lost structures by similar structures, thus restoring original function and appearance. The operation can be performed unilaterally or bilaterally, or combined with such operations as Estlander's or Burow's, and also with resection of the mandible. Photographs taken in 4 cases are shown.

Preserved cartilage is regarded by Wolf[34] as most generally useful for filling out the contours of receded chins. He reports a case in which, the hump removed from the patient's nose having proved too fragile to be used in the chin, preserved cartilage was employed as an expedient.

(Comment: It should not be forgotten that the patient's septal cartilage might have served in this contingency and that it has the additional advantage of being an autograft. Autogenous septal bone is likewise good grafting material. Clinical and experimental work have demonstrated that preserved cartilage grafts tend to be absorbed over periods of time.)

Campbell[35] presents a method of treating gross fracturing of the facial bones, adding the insertion of submalar wires and the application of a nasal stirrup in modification of other methods. In the illustrated case the patient was found to have gross fracturing of the maxilla and the mandible, flattening of the nose into the ethmoid bones, fracturing of the zygomatic arches, with widening, and retrodisplacement of the malar bones. Control of the maxilla and the mandible was gained by means of a long facial bar held by a plaster head cap and fastened to the half round dental bars which had been wired to the teeth at the time of the reduction of the manibular fracture. The fractures of the malar bones were reduced and the fragments held in place by wires passed through drill holes made in the external angular processes and frontal bones. The drill holes were made and the wires inserted through small supraorbital incisions. The wires were then brought out through the upper buccal sulci and fastened to the upper dental bar on the maxillary teeth. By means of these wires the malar fragments could be readjusted. Pull out wires were placed at the time when the other wires were inserted into the drill holes. Control of the nasal fragments was attained by a supporting stirrup fastened to the long facial bar. A plaster of paris chin support may be added and attached to the lateral sides of the plaster head cap.

For the past five years Stewart and Conley[36] have used the temporal approach of Gillies for reduction of zygomatic fractures. They have

34. Wolf, G. D.: Receded Chin: Its Correction with Preserved Cartilage, Am. J. Surg. **72**:74 (July) 1946.

35. Campbell, H. H.: Method in the Management of Multiple Facial Fractures, Surgery **20**:204 (Aug.) 1946.

36. Stewart, M. B., and Conley, J. J.: Fractures of the Malar-Zygomatic Compound, Arch. Otolaryng. **44**:443 (Oct.) 1946.

corrected 24 fractures of this type with good cosmetic and functional results and with complete absence of postoperative infection.

Occasional situations arise in which the entire thickness of the bone of the mandible must be removed but a few shreds of periosteum may be left bridging the gap between the bones. Byars[37] believes that such a condition can occur with adamantinoma, ossifying fibroma, osteoma and even some more simple tumors. In this event the lingual and the buccal periosteum are preserved if possible, the oral mucous membrane is closed and the fragments are maintained in their proper relationship. The last is best effected, especially in children and in edentulous adults, by inserting an internal bar of stainless steel between the bone ends. Regeneration may be remarkably rapid, especially in children.

It is believed by Cook and his associates[38] that certain essential steps should be followed in the treatment of gunshot fractures of the mandible. Control of hemorrhage, establishment of an adequate airway, temporary immobilization of the fractured bone and treatment of shock are to be considered first. This is followed by minimal primary excision, without suture except when conditions are favorable for primary closure, and early immobilization of the fractured bone. Secondary minimal excision and débridement are done from five to ten days after the injury, accompanied or followed by delayed primary closure of the cutaneous wound. The authors recommend that osteomyelitis be treated by early radical operation.

Weiss[39] holds that in the treatment of fractures of the facial bones the control of bone fragments is vital, since the success of treatment depends largely on immobilization and stability.

The time of treatment can in a measure be estimated, and the final result may be visualized from the success or the failure of treatment. Failure to secure proper stabilization often results in faulty union and possible unnecessary loss of substance from the ends of the bones or the death of viable fragments that should not have been lost. Improper or incomplete stabilization frequently necessitates operative procedures that would not have been necessary had there been complete immobilization. The planning and the working out of a procedure of fragment control adaptable to a particular case are paramount, whatever the means of accomplishment.

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37. Byars, L. T.: Subperiosteal Mandibular Resection with Internal Bar Fixation, Plast. & Reconstruct. Surg. **1**:236 (Sept.) 1946.

38. Cook, T. J.; Royster, H. P., and Kirby, C. K.: Treatment of Gunshot Fractures of Mandible, J. Oral Surg. **3**:326 (Oct.) 1945.

39. Weiss, L. R.: Control of Bone Fragments in Maxillofacial Surgery, J. Oral Surg. **3**:271 (Oct.) 1945.

Vaughan[40] describes his method of retroplacing the premaxilla in "complicated" bilateral cleft lip and palate. He believes that by chiseling through the vomer into the cartilaginous part of the septum (with the mucoperiosteum retracted) the premaxilla may be retroplaced without rotation, which results in backward angulation of the incisors. The premaxilla, however, is not pushed back far enough to form what appears to be the normal dental arch, since, as Vaughan states, it is far better to have a premaxilla too far forward than to have it fall back and fail to support the lip.

As expressed by Hersh,[41] the problem of repairing a large alveolar-antral fistula of long standing is always difficult, and the surgeon is pressed to select a procedure which will most likely be successful in a given case. When the defect is large, one should satisfy the principles set down in plastic surgery for repairing a defect in the wall of a body cavity, i.e., the construction of both lining and covering. The author reports successful closure of a large alveolar-antral fistula by twisting over one flap of mucous membrane for lining and advancing a flap on the opposite side of the opening to serve as a covering.

(Comment: Another method which avoids redundancy due to twisting is to turn in a "trap door flap" for lining and to cover the raw surface of the trap door by advancing mucous membrane from the opposite side. In large openings this should be done in two stages to insure adequate blood supply for the flaps.)

In discussing nasopharyngeal stenosis Kazanjian and Holmes[42] state that the condition consists in scarring and constracture of the mucous membrane and submucosal tissues of the nasopharynx following destructive damage. This process may involve the posterior pharyngeal wall anywhere from the adenoids down and, in addition, may include the lateral walls and extend forward to the pillars of the fauces. There are all degrees of involvement, from moderate distortion of the normal anatomy, not giving rise to symptoms, to inclusion of all the structures, resulting in a contracture ring. This ring distorts the entire nasopharynx and occludes it with a thick diaphragm of scar tissue, which gives rise to nasal obstruction and a change in voice. The authors repaired the condition in their earlier patients by forming mucous membrane flaps from the nasal and oral surfaces and suturing them in a manner to cover the raw areas on the pharynx and the palate. They found that the

40. Vaughan, H. S.: The Importance of the Premaxilla and the Philtrum in Bilateral Cleft Lip, Plast. & Reconstruct. Surg. **1**:240 (Sept.) 1946.

41. Hersh, J. H.: Plastic Repair of Large Alveolar-Antral Fistula, Arch. Otolaryng. **43**:141 (Feb.) 1946.

42. Kazanjian, V. H. and Holmes, E. M.: Stenosis of Nasal Pharynx and Its Correction, Arch. Otolaryng. **44**:261 (Sept.) 1946.

palatal flap was not adequate to cover the raw palatal defect completely; so for this purpose an additional flap, turned in from the buccal mucosa, was utilized. A diagram, which is reproduced in this review, clearly indicates the technic of the procedure.

According to Beatty,[43] the history of attempts to correct cleft palate

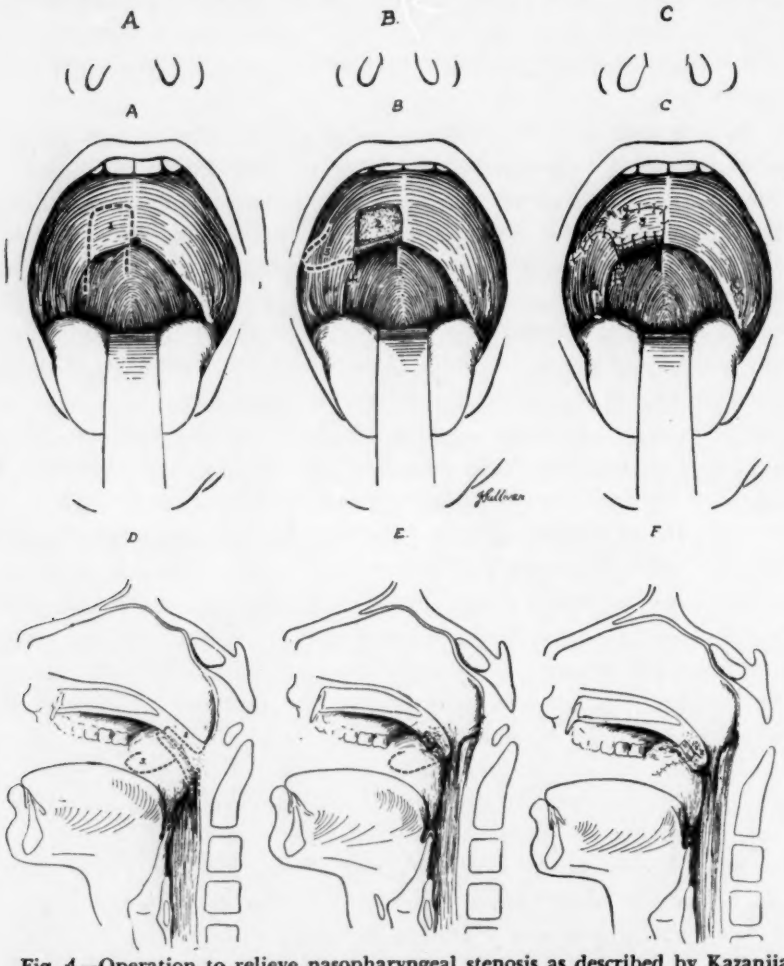

Fig. 4.—Operation to relieve nasopharyngeal stenosis as described by Kazanjian and Holmes.[42] The stenotic tissue on the right was comparatively soft, whereas that on the left consisted of a tight thick band. In *A* a continuous dotted line indicates the incision. *B* shows the two flaps sutured in place, leaving a raw surface, which is to be covered with flap *3* taken from the mucosa. In *C* flap *3* is seen sutured in place, thus covering all the denuded area. *D* is a cross section diagram illustrating the incisions which created the three flaps surfaced with mucous membrane. *E* illustrates the creation of the two flaps, both lined on one surface with mucous membrane. *F* shows the relative position of the three flaps when held in place.

43. Beatty, H. G.: Cleft Palate, Ann. Otol., Rhin. & Laryng. **55**:572 (Sept.) 1946.

goes back to 1766, when Le Mormir reported his results. Eustachi, in 1779, reported results, and in 1783 he wrote what seems to Dorrance to have been the first description of a technic for closure of cleft palate.

The fundamentals of corrective measures for cleft lip and palate have remained the same for the past fifty years. However, variations, improvements and undesirable methods have naturally been introduced by many during the last half century. In selecting the method for his adoption, the young surgeon has a variety from which to choose and should select a satisfactory one which is acceptable to the majority of competent men and which he in particular can do best. Later he can add his own variations.

In an article replete with excellent illustrations, Dorrance and Bransfield[44] review the indications and methods of correction of the five types of congenital deformity of the palate which they utilize after more than twenty years' experience.

They emphasize the importance of velopharyngeal closure in permitting normal speech, insisting that, in accomplishing this, "the simple repair of any cleft in the soft palate cannot have the slightest effect." A cleft in the soft palate is closed at the same time the "push-back" is done, whether at the second or the third stage. At the first operation, in all cases, the palatine arteries are cut, and at the second the hamular process is divided, "thus transposing the tensor palati muscle from a tensor to an elevator muscle."

Dorrance and Bransfield believe in the principle that there should be no raw area on the nasal surface, but they prefer to cover this with a skin graft rather than to attempt to retain the nasal mucous membrane. In complete unilateral or bilateral clefts, their first step is always the raising of a vomerine flap and the suturing of it "leaf-of-the-book-wise" to the palatal flap. If the vomer should appear to be "only a remnant" at birth, it may be so developed a year or so later that its flaps can be utilized.

"Generally speaking," they state in regard to secondary corrections, "a modified push-back forms the basis of correction on all patients who still have a palatal insufficiency and speak with the characteristic nasal tone."

The most accurate method of identifying a branchial cyst consists in aspirating and examining its contents, according to Neel and Pemberton.[45] If cholesterol crystals are present in the fluid, that is positive evidence of a cyst. In addition, when the fluid of a branchial cyst is placed

44. Dorrance, G. M., and Bransfield, J. W.: The Push-Back Operation for Repair of Cleft Palate, Plast. & Reconstruct. Surg. **1**:145 (Sept.) 1946.

45. Neel, H. B., and Pemberton, J.: Lateral Cervical (Branchial) Cysts and Fistulas: Clinical and Pathologic Study, Surgery **18**:267 (Sept.) 1945.

in a basin, the high lipoid content imparts a yellowish sheen. This is not seen in tuberculous exudates. Complete excision of the cyst or the fistula is recommended in the majority of cases. Conservative treatment is indicated in the presence of acute inflammation.

As pointed out by Newman and Seabrook,[46] it is a generally accepted fact that surgical repair of lacerations or injuries of Stensen's duct has been notoriously unsuccessful. All too often it results in complete failure. Despite this gloomy prognosis, occasional cases of successful immediate

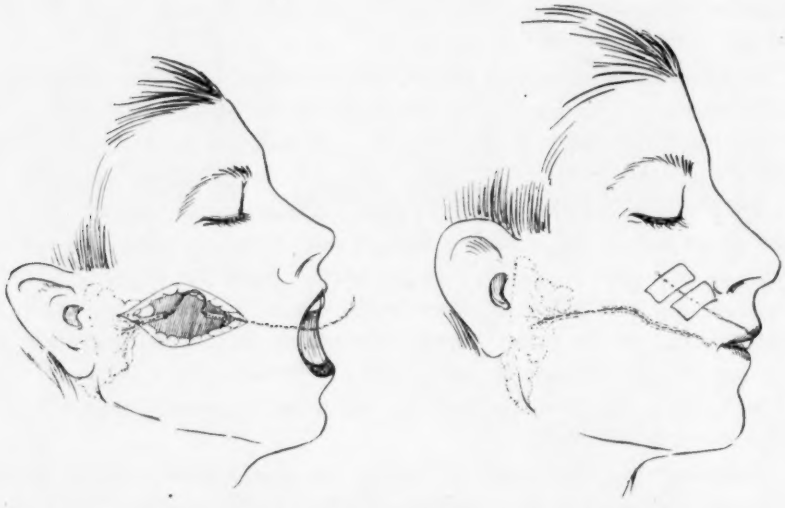

Fig. 5.—Treatment of fistula of Stensen's duct after the manner of Newman and Seabrook.[46] At the left a twisted tantalum wire has been drawn through the distal segment of the duct and is being inserted into the proximal segment. At the right the twisted wire is in the correct position. It occupies the lumen of the proximal and distal segments of the duct and the gap between these segments.

repair have been reported, but few, indeed, are the reports of success in the treatment of the more chronic types of fistula.

They state that there are several reasons for this: The injury is so rare that no one person has acquired any considerable experience in repairing it. There are inherent difficulties in the peculiar anatomy and relations of Stensen's duct which make surgical treatment hazardous. Although many of the operations and procedures described are excellent in principle, none are complete. Furthermore, a comprehensive preoperative and postoperative regimen has never been published.

While on duty at an Army general hospital during the war Newman and Seabrook encountered a number of injuries of Stensen's duct, and

46. Newman, S. C., and Seabrook, D. B.: Management of Injuries to Stensen's Duct, Ann. Surg. **124**:544 (Sept.) 1946.

as a result they have devised an operation for chronic fistula of the duct, which is illustrated in this review.

Maliniac[47] presents 2 cases of reconstruction of the upper part of the auricle, emphasizing the need for individualizing methods of repair in such cases. In one case a supraclavicular tube flap was used to form the helix over a cartilaginous part. The flap consisted of two split grafts with a cartilaginous layer between them, the grafts being transferred by pedicle from the region of the mastoid process. In the other case, a fine retroauricular tube was used, which was reenforced by a small piece of cartilage.

The importance of complete anatomic section for correction of the congenital protruding ear is stressed by Seeley.[48] After marking with dye, he elevates triangular flaps of cartilage and removes an arrowhead pattern segment from each triangular flap. Mattress sutures are inserted to obtain abutment of the concha and scapha cartilages so as to preserve the new antihelix.

(Comment: This procedure seems rather radical. One wonders what the contour of the crura on the anterior surface of the auricle will be when prominent ears are repaired by this method.)

Tantalum was used by Carmody[49] in the repair of cranial defects. He observed that it acted as a foreign body in some cases and had to be removed. In place of tantalum, cancellous bone is recommended for use in the repair of small and medium-sized defects. The bone graft is removed from the crest of the ilium, and the cancellous chips, averaging 1 cm. in diameter, are placed in mosaic layers, entirely filling the defect. Chips of this size are readily bitten off the graft with a rongeur. As a final step, the periosteum surrounding the exposed defect of bone is incised and turned back over the borders, partially enclosing the cancellous chips. The scalp flap is sutured, and a light compression dressing is applied.

(Comment: Diced autogenous cartilage grafts may be used in place of the chips of cancellous bone for the repair of cranial defects. Both methods provide a natural rounded contour, because the separate small grafts can be molded to conform with the convexity of the skull.

There is a growing trend among plastic surgeons to use only autogenous transplants whether of cartilage, bone or other tissues. The mem-

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47. Maliniac, J. W.: Reconstruction of Partial Loss of Ear, Plast. & Reconstruct. Surg. **1**:124 (Sept.) 1946.

48. Seeley, R. C.: Correction of the Congenital Protruding Ear: New Surgical Concept, Am. J. Surg. **72**:12 (July) 1946.

49. Carmody, J. T. B.: The Repair of Cranial Defects with Special Reference to the Use of Cancellous Bone, New England J. Med. **234**:393 (March 21) 1946.

bers of this department have consistently advised that autogenous grafts be used in preference to foreign grafts.)

Money[50] believes that repair of the damaged cranial vault and meninges should be carried out not only for the relief of symptoms and signs caused by adhesions and scars of the brain but also for psychologic and cosmetic reasons. Since inert materials, such as vitallium and tantalum, have caused foreign body reactions and have psychologic disadvantages, Money prefers autogenous bone. Following the advice and method of Pickerill (1931), he uses the inner table of the ilium and regards it as the ideal graft for a deficiency of almost any size.

In following up his work Money found that whereas bone taken from a cadaver may be entirely absorbed, roentgenologically speaking, in the space of six years (though the defect is quite solid "to the touch") bony union usually occurs in autogenous ilium grafts.

NOSE

The nose is important as an airway and as a moistener and warmer of inspired air. The commonest causes of nasal blockage, according to Lamont,[51] are allergic rhinitis, deviation of the septum or a combination of both. When function has been disturbed, an otolaryngologist should be consulted prior to nasal reconstruction. In reconstructing a septum the anterior part of which is twisted, no purpose is served by submucous resection. Lamont prefers to deflect the mucous membrane on the convex curve of the deformed septum and then to resect a thin "hyperbolic" sliver of cartilage extending from the dorsum down to the nasal spine or more anteriorly. He removes a second piece of cartilage more anteriorly when this is required. The mucous membrane is replaced, and staggered sutures are taken between the separated sections of the cartilaginous septum (illustrated). Lamont advises against combining extensive submucous resection with rhinoplasty.

As pointed out by Cohen,[52] nasal plastic surgery today is being practiced by physicians of varied background and training. Not only are general plastic surgeons and otolaryngologic surgeons doing rhinoplasty, but general surgeons are trying their hand at it. Rhinoplasty has now become a fairly common operation. To obtain good results, those performing it must be well trained in internal as well as in external nasal

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50. Money, R. A.: The Repair of Cranial Defects by Bone Grafting, Surgery **19**:627 (May) 1946.

51. Lamont, E. S.: Physiology of the Nose and Its Relation to Plastic Surgery, Am. J. Surg. **72**:238 (Aug.) 1946.

52. Cohen, S.: Planning the Rhinoplasty, Arch. Otolaryng. **43**:283 (March) 1946.

anatomy and physiology. In other words, it is the otolaryngologist who is best qualified to specialize in this work, according to the author.

More important than having fine surgical ability (technical skill) are an understanding of the abnormal structure of the particular nose and

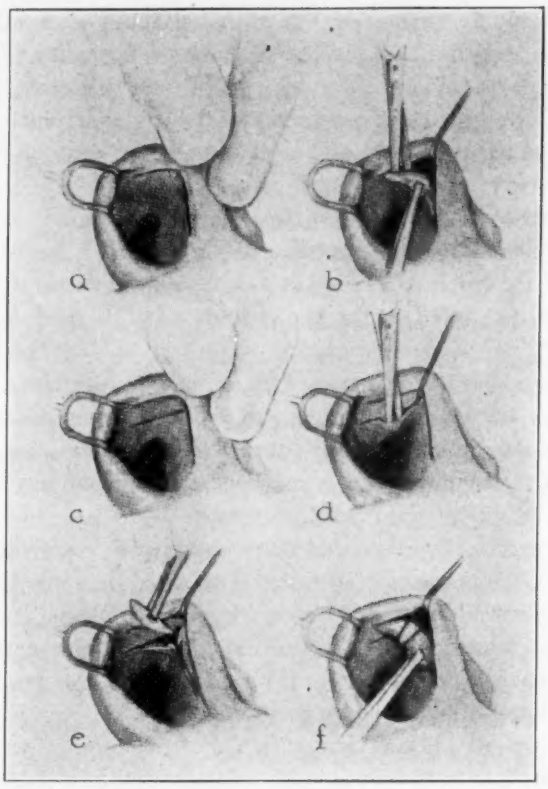

Fig. 6.—Becker's[53] correction of enlarged alar cartilages: (*a*) An incision is made along the anterior border of the medial and lateral crura as indicated by the line. (*b*) The cartilage is dissected from the overlying skin. (*c*) The lateral crus is split transversely on the line, to separate it into an upper and a lower segment. (*d*) The skin on the under surface of the upper segment is dissected away from the cartilage. (*e*) The upper segment of the cartilage, free of skin, is removed. (*f*) The lower or rim segment is pulled outward and a wedge of cartilage, with skin attached, is removed from the angle between the medial and the lateral crus.

the planning of the proper steps to obtain a pleasing result. The planning and the execution of the corrective steps are the important elements in this work.

The basic principles of rhinoplasty were formulated many years ago by Jacques Joseph, of Berlin, as pointed out by Becker.[53] The nasal plastic procedures of today differ from the technic of Joseph only in

53. Becker, O. J.: Aids in Rhinoplastic Procedures, Ann. Otol., Rhin. & Laryng. **55**:562 (Sept.) 1946.

certain details. Shaping of the nasal tip is one of the most important procedures in obtaining a natural, "nonsurgical" appearance of the nose. Not infrequently, after proper removal of the hump and fracture of the nasal bones, the result is unsatisfactory because of inadequate or faulty modeling of the lower lateral cartilages. Considerable judgment and experience in correctly evaluating the proper shaping of the lower lateral cartilages are essential, because no 2 patients are alike. A procedure which Becker uses embodies the principle of splitting each lower lateral cartilage into two fields, an upper and a lower, and removing a wedge at the angle of the two crura and a segment of the anterior border of the medial crus.

In deviation of the nasal septum, the important point, in the opinion of Reid,[54] is whether or not it obstructs the airway. A "septum test" has been devised in which a wisp of cotton is held in front of each nostril and the patient is asked to breathe in and out. The relative amounts of movement of the two wisps indicate the degree of ventilation. The lasting benefits to be gained from operation can be estimated by applying this test after decongesting the mucosa with cocaine and epinephrine. The actual bony or cartilaginous obstruction will thus be manifest. If the septal deflection, per se, is causing the obstruction, a submucous resection of the nasal septum is indicated.

Nasal obstruction may be due to turbinal hpyertrophy alone. Reduction or partial removal of one or more of these bodies will then afford relief. Even considering the necessary sacrifice of a portion of the mucosa, such treatment seems justified to relieve the patient.

(Comment: All well trained otolaryngologists are opposed to radical removal of functioning mucous membrane whether this is in the nasal cavity or in the adjacent accessory sinuses. Reduction of an enlarged inferior turbinate to a size which conforms with the width of the nasal cavity, however, is a procedure of necessity in certain instances. A typical example is the patient with a septum so deflected to one side that it completely blocks the anterior part of the nasal cavity. On the opposite side the inferior turbinate has undergone compensatory enlargement so that it extends to the midline of the nasal cavity. But, owing to the concavity of the septal deflection, the patient can breathe normally through this side. When the deflected septal cartilage is removed, however, the septal mucous membrane flaps, which are restored to a midline position, will rest against the enlarged turbinate. This causes complete obstruction of breathing on the side which was previously open and restores normal breathing space on the side which was obstructed. In such cases the hypertrophied turbinate should be trimmed to conform with the new position of the septal membrane flaps.)

54. Reid, W. O.: Some Observations on Nasal Obstruction, M. Press **214**:153 (Sept. 5) 1945.

Fomon and his co-authors[55a] state that the nasal septum does not provide the main support for the dorsum of the nose. Saddle depression of the nose following radical submucous resection occurs some time after the operation and is due to contracture of fibrous tissue, which in the absence of a rigid septal cartilage draws the less resistant alar or lateral cartilages downward. To obviate this postoperative deformity following wide removal of the septal cartilage, the authors insert a free segment of septal cartilage in the columella or in a more posterior position between the mucous membrane flaps. This method of utilizing a free septal cartilage graft between the septal mucous membrane flaps to provide "potential" support for the nose is presented as an original procedure. The authors support the soundness of their hypothesis by referring to the work of Sir Isaac Newton, to the cantilever principle used for gables in engineering and to the work of one another.

(Comment: The members of our department disagree with Fomon and his co-authors regarding the importance of the nasal septum as a support for the lower dorsal line of the nose. On the basis of a large clinical experience we believe that when the septal cartilage is completely removed, a saddle deformity will result at the time of operation. The operation which Fomon accredits to Galloway is not original with the latter. It has been described in the literature at least three times.[55b] Fomon's procedure is a simple modification of this method in which he inserts the septal cartilage graft in a more posterior position between the septal mucous membrane flaps.

It is a well established fact that autogenous septal cartilage will survive between the mucous membrane flaps of the septum, but it is not wise to remove the supporting beam of septal cartilage indiscriminately. This method is a procedure of necessity rather than of routine choice and should not be used by the occasional operator. [See editorial "Supporting Function of the Septal Cartilage" in the first part of this review.])

The view is held by Kayser[56] that regardless of whether dislocation of the septal cartilage occurs alone or is associated with deflection of the bony septum and with an external bony deformity, the same operative procedure can be followed. This procedure is to remove the deformed

55. (*a*) Fomon, S.; Syracuse, V. R.; Bolotow, N., and Pullen, M.: Plastic Repair of the Deflected Nasal Septum, Arch. Otolaryng. **44**:141 (Aug.) 1946. (*b*) Peer, L. A.: An Operation to Repair Lateral Displacement of the Lower Border of the Septal Cartilage, ibid. **25**:475 (April) 1937; Cartilage Grafting, S. Clin. North America **24**:408, 1944; Septal Operation for Anterior Nasal Deformity, Surgery of Nose and Throat, in Nelson's Loose-Leaf Living Surgery, New York, Thos. Nelson & Sons, 1942, p. 109, fig. 86.

56. Kayser, R.: New Operation for Dislocated Septal Cartilage, Am. J. Surg. **72**:248 (Aug.) 1946.

septal cartilage completely and to support the nose by use of the upper lateral cartilages and a columellar strut. Saddle deformity follows submucous resection only when the upper lateral cartilages end short of the distal end of the septum.

(Comment: The members of this department oppose complete removal of the septal cartilage as a routine procedure. It is indicated only when the displaced cartilage segment cannot be "hinged" and replaced in proper position. When the septal cartilage is completely removed, a saddle depression will usually result, regardless of the relationship between the lateral and the alar cartilages.)

In the opinion of Elsbach,[57] reconstruction of the external nose is accomplished according to more or less fixed principles as originally described by Joseph; the reconstruction of the septal cartilage, however, requires ingenuity on the part of the surgeon and demands an individual technic in each case. When the deviation of the septal cartilage is only in or near its articulation with the perpendicular plate of the ethmoid, it is best handled by freeing the whole cartilage, separating the mucoperichondrium on one side only and removing a narrow strip of cartilage at the site of the deviation, thus eliminating the "spring." This procedure enables one to swing the cartilage into its normal position as on a hinge.

But there are many cases in which the deviation and distortion are in the lower part of the septal cartilage near the columella. The displaced cartilage may also be so thickened and distorted that it will not serve for adequate support of the nasal tip when it is replaced. In such cases the author advocates a modification of Peer's operation, in which the distorted cartilage at the tip is removed and a straight segment of septal cartilage is substituted in its place as a free cartilage graft. Elsbach, however, leaves an untouched piece of cartilage as a support immediately behind the segment of cartilage inserted between the skin folds of the columella. This, in his opinion, precludes the possibility that the dorsum of the nose might later sag.

(Comment: We have not noted sagging of the nasal dorsum in any of the patients repaired by Peer's method, but Elsbach's modification provides additional support, which may be of value if later the nose is subjected to trauma. At any rate it is refreshing to read an article stressing the importance of septal support when a large number of self-styled experts are trying to prove that the septal cartilage is a useless and outmoded appendage.)

The clinical importance of septal cartilage grafts for the correction of various types of nasal deformity is emphasized by Peer.[58] Experimental

57. Elsbach, E. J.: Cartilaginous Septum in the Reconstruction of the Nose: A Modified Procedure, Arch. Otolaryng. **44**:207 (Aug.) 1946.

58. Peer, L. A.: Neglected Septal Cartilage Graft (with Experimental Observations on the Growth of Human Cartilage Grafts), Arch. Otolaryng. **42**:384 (Nov.-Dec.) 1945.

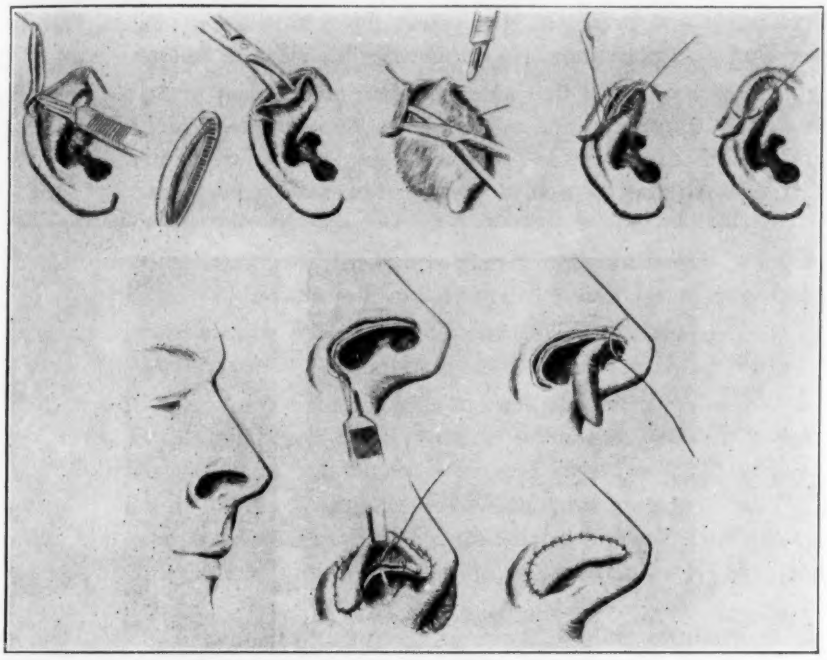

Fig. 7.—Repairing the border of a nostril with a free composite graft of aural skin and cartilage by the method of Brown and Cannon.[59]

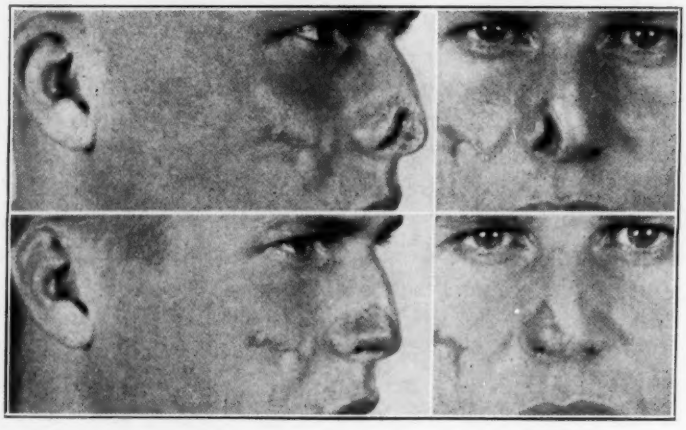

Fig. 8.—Large defect of a nostril and its repair as effected in a single operation with a free composite graft of skin and cartilage taken from the ear (method of Brown and Cannon[59]). The donor ear was restored, with minimal deformity, by means of a flap brought forward from the scalp.

evidence is also presented that young septal cartilage grafts increase in size after transplantation. He summarizes his views as follows:

The general belief that autogenous septal cartilage grafts do not survive after transplantation is erroneous. Autogenous septal, alar, lateral and costal cartilages all survive after being transplanted as living cartilage. All may be used successfully for grafting purposes.

Autogenous septal cartilage is superior to alar and auricular cartilage only because of its greater bulk and firmer structure. It is superior to costal cartilage because it is more readily obtainable.

Autogenous septal cartilage should be used whenever it is adequate to support a nasal defect (with septal bone being added when necessary).

When the nasal depression is sufficiently large to require costal cartilage, autogenous costal cartilage is the material of choice. Preserved cadaveric cartilage may be used in debilitated or elderly patients.

Peer's experimental observations indicated actual growth of young human auricular and septal cartilage grafts. The more bulky young costal cartilage grafts increased in some cases and in others showed no increase in size.

Septal bone grafts without periosteum transplanted beneath the abdominal skin retained their normal bone structure for periods up to four years after transplantation. Rib and tibial bone with and without periosteum transplanted beneath the abdominal skin completely disappeared seven months after transplantation.

Brown and Cannon[59] used free grafts taken from patients' ears, consisting of two surfaces of skin with cartilage between, for replacement of tissue lost from areas such as the border of the nostril, the nasal tip and the columella. These defects they corrected in one procedure, with excellent results in respect to the appearance of the patient. Additional advantages were minimal deformity at the donor site and avoidance of bulky flaps. The ear can be repaired with a local cutaneous flap, or the denuded portion of the auricle can be buried under a scalp flap brought up from behind. The ear is freed and the defect grafted after a period of two to three weeks. The method has been used successfully to replace the entire columella, the tip of the nose and an extensive portion of one nostril (figs. 7 and 8).

Following up their first article on the subject of free grafts from patients' ears, which was recently published, Brown and Cannon with their co-workers[60] report additional cases. They have used a free graft

59. Brown, J. B., and Cannon, B.: Composite Free Grafts of Skin and Cartilage from Ear, Surg., Gynec. & Obst. **82**:253 (March) 1946.

60. Brown, J. B.; Cannon, B.; Lischer, C. E.; Davis, W. B.; Moore, A., and Murray, J.: Further Reports on Use of Composite Free Grafts of Skin and Cartilage from the Ear, Plast. & Reconstruct. Surg. **1**:130 (Sept.) 1946.

from the ear, sometimes containing cartilage as well (composite graft), in 50 cases, with failure in only 4. The grafts are indicated particularly when tissue has been lost from the alar and columellar regions or from the tip of the nose. Defects of all three may be repaired with one graft.

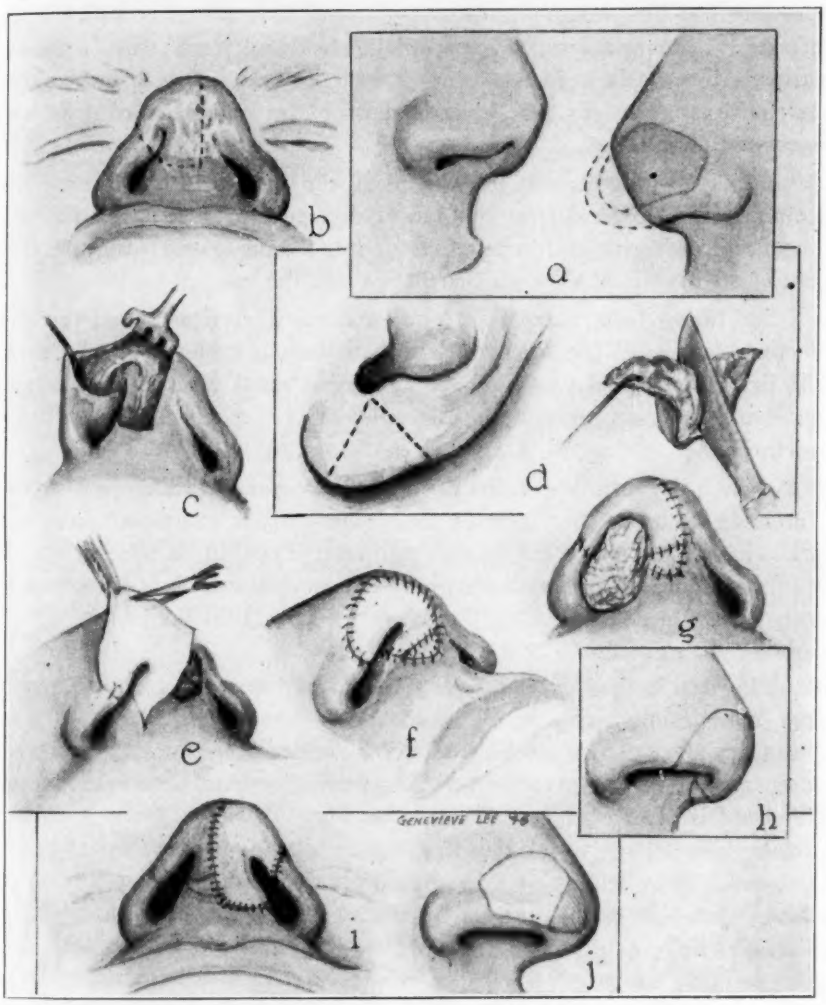

Fig. 9.—Reconstructing a deformed nasal tip with a free graft of skin and fat taken from an ear lobe, by the method of Dupertuis.[61]

The graft is taken from the helix, which, in turn, is repaired with a local flap. It is stated that the margin of the helix and that of the ala match almost perfectly in color.

According to Dupertuis,[61] free grafts of skin and fat taken from ear lobes have proved of great value in making surgical repairs about nostrils because of their contour, color and surface texture. In a well illustrated article including color photographs he demonstrates his technic. About half of the ear lobe is excised, the graft is "tailored," split if necessary to enclose alar cartilage, and sutured accurately with 6-0 silk. Gentle pressure and firm immobilization of the transplant are effected by nasal packing combined with a stent mold, held in place with adhesive strips. If both alae need repairing, both lobes may be used, but at different times. The ear lobe itself is repaired by simple suturing of the wedge-shaped defect.

Dupertuis suggests that the lobe of an ear be used in lengthening the columella in bilateral cleft lip. He gives credit to Joseph (1912) for the first composite graft transplant and to Konig (1914) for the first use of free grafts of skin and cartilage from the ear.

For many years Kazanjian[62] has utilized a vertical flap from the median section of the forehead to repair various types of nasal defect. At first this method was used only for small nasal defects, until it was gradually realized that large defects could be repaired by the same method.

Briefly, the technic consists of making two parallel incisions over the forehead, from ½ to 1 inch (1 to 2.5 cm.) apart, extending from the hair line to just above the frontal eminence. This flap is raised from its bed, and when it reaches the region of the eyebrows, blunt dissection is carried downward almost to the root of the nose; thus the frontal vessels are saved from injury.

The flap is then employed as a means of supplying tissue to repair the defect of the nose.

The defect of the forehead is closed immediately by approximating the edges of the wound; the resulting vertical scar in the center of the forehead is a surprisingly inconspicuous line. Of course, there is an upper limit to the size of the flap that can be taken from the forehead with the donor area being closed by simple approximation of the borders of the wound. The size of the forehead and the degree of elasticity of the skin also have a bearing on the use of this method. Patients with low hair lines do not supply much tissue for the repair of a large defect. It is also apparent that in young people the skin of the forehead is more difficult to stretch, while in older patients it is usually quite lax and the borders of a forehead wound are more easily approximated (fig. 10).

61. Dupertuis, S. M.: Free Ear Lobe Grafts of Skin and Fat, Plast. & Reconstruct. Surg. **1**:135 (Sept.) 1946.

62. Kazanjian, V. H.: Repair of Nasal Defects with the Median Forehead Flap: Primary Closure of Forehead Wound, Surg., Gynec. & Obst. **83**:37 (July) 1946.

In using the sickle forehead flap for nasal reconstruction New[63] finds it necessary to follow the delayed flap technic in order to insure the blood supply. The area to be used is marked out with blue pencil on the forehead just lateral to the midline and just below the hair line. The hair is shaved, and a flap is marked out with indelible pencil while adhesive tape or gauze bandage is used as a pattern so that the flap will be of sufficient length at the time of operation. The lower margin of the flap determines its length. The flap is elevated, both pedicles being left intact. At this time or at a second stage the mesial end of the flap may be lined with a shaved skin graft as in making an ala, so that it will have skin on both sides. At the subsequent stage the forehead end of the pedicle is cut across, and at a later stage the

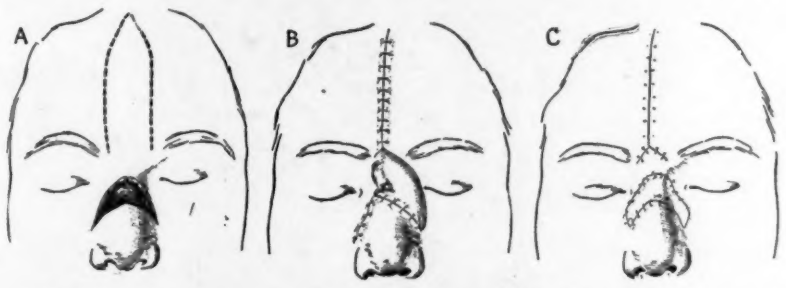

Fig. 10.—Kazanjian's[62] method of repairing a defect of the nose. In *A* the entire skin and cartilage of the lower part of the nose have been freed upward and swung down. Also a median forehead flap has been outlined. In *B* the flap is seen filling the defect of the left side of the nose. In *C* the defect of the left side of the nose is filled by the proximal part of the median forehead flap.

flap is brought down to the defect in the nose. If the flap is to be used to reconstruct the lower half of the nose, including the tip and the columella, and has to be folded on itself, a better-shaped nose is obtained by not bringing down the flap until three months after it has been prepared.

At the time of the operation the raw surface on the forehead is completely covered with a shaved graft. After the flap has been in place for two weeks, the point in the flap that will form the distal margin of the reconstructed part is cut half way across and sutured; a week later it is completely cut across, and the pedicle and distal portion of the flap are replaced on the forehead after removal of the skin graft. In many cases it is possible to stretch the flap so that the entire skin graft may be replaced with the flap; thus no skin graft is left visible at the lower margin of the hair line. This lowers the hair line a

63. New, G. B.: Sickle Flap for Nasal Reconstruction, Proc. Staff Meet, Mayo Clin. **20**:353 (Oct. 3) 1945.

little, but in most patients not enough to be noticeable, and New feels that it is a distinct advantage. If it is impossible to remove all the skin graft, the lower and mesial portions of it which remain may be excised at a secondary operation.

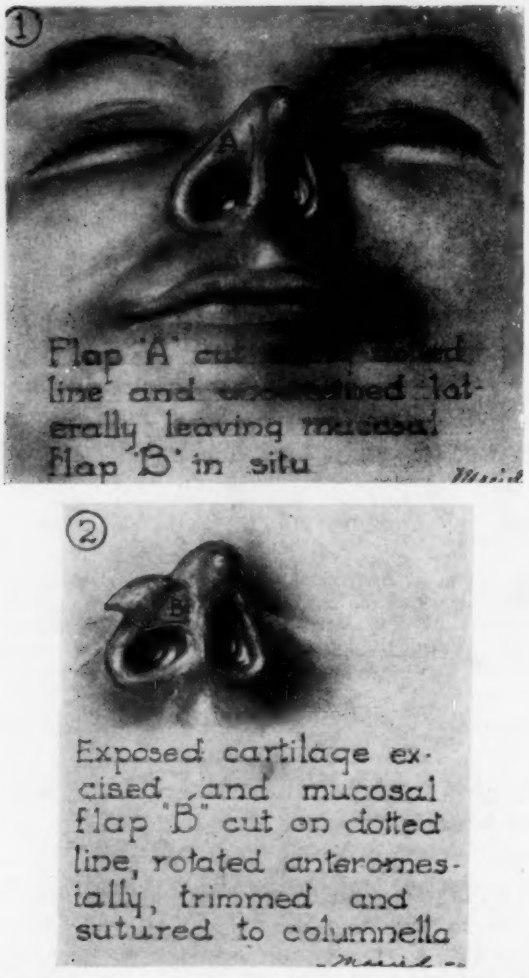

Fig. 11.—Straith's[65] correction of flat nose and short columella.

Blair and Byars[64] give an excellent presentation of pedicle flaps used for correction of nasal deformities. They emphasize that the part of the flap which is to form the alae and tip and be infolded for lining must be made very thin and at least 5 cm. wide. This is often not possible on

64. Blair, V. P., and Byars, L. T.: Hits, Strikes and Outs in Use of Pedicle Flaps for Nasal Restoration or Correction, Surg., Gynec. & Obst. **82**:367 (April) 1946.

a woman's forehead unless some scalp is included. In older men a receded hair line may be an advantage, since it provides a wider area of hairless skin. Arm or body flaps may be used to repair nasal deformities, but they always differ in color from the normal skin of the face, a circumstance which detracts from an otherwise acceptable result. When the nose has been repaired with a forehead flap, the defect in

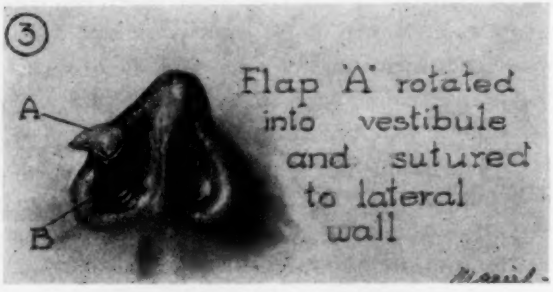

Fig. 11 Continued.

the forehead is first covered with a split graft, which is later discarded for an evenly fitted full thickness graft from the abdomen. This graft, which is usually too light in color, is later tattooed with pigments to render it a better match for the surrounding forehead skin. The tenacity with which the transplant clings to the color characteristics of its source suggests the possibility of some intrinsic local control. For example, grafts taken from below the clavicle will, in most instances, eventually lose all vestige of red, while flaps from the cheeks or the forehead and postcrural grafts will retain or regain their natural blush shade.

(Comment: Dr. Vilray Blair is one of the world's great plastic surgeons. He has performed more total nasal reconstructions than any living American surgeon. This fine contribution should therefore be read in the original by all surgeons interested in total reconstruction of the nose.)

By an ingenious use of the Z plastic principle, Straith[65] has found a new way to lengthen the nasal columella. In this method the narrow upper lip with tight midline scar and other objectionable features of the operation which utilizes the philtrum are avoided. Straith's procedure finds its greatest usefulness in the correction of the flat ala and the distorted nostril associated with single cleft lip, and the short columella with the flattened nasal tip seen with double cleft lips; but it is also applicable to congenital flat nose with short columella (figs. 11 and 12).

In reviewing the literature Weaver and Bellinger[66] found only thirteen contributions dealing with the deformity known variously as bifid, cleft or double nose. Only three appeared in the North American literature. The authors report a case of bifid nose associated with median cleft of the the upper lip and the usual excessive width between the nasal processes of the superior maxillas and also between the eyes. The excessive amount of skin was removed by an external elliptic excision, the widely separated alar and lateral cartilages were sutured together, and the wide columella was reduced in size. Weaver and Bellinger considered fracture and narrowing of the wide bony nasal bridge but thought that the procedure, if undertaken early, might inhibit development of the sinuses and interfere with the general development of the nose.

(Comment: See editorial "Bifid Nose" in the first part of this review.)

MISCELLANEA

In discussing plastic surgical care given to wounded service men, John Staige Davis[67] stated:

> There has been great improvement in the treatment of wounds of all kinds and in the methods of dressing wounds. There is better understanding of the handling of scar tissue. The methods of inducing anesthesia, and also of surgical technic have been improved along every line. New technics have been developed in the last few years in skin grafting and flap shifting, and, in fact, in all types of tissue transplantation, and all of these advances in knowledge are being constantly used. Another great advance is the marvelous improvement in the methods and speed of evacuating the wounded. Many more lives are saved than would have been possible in World War I, and better operative results are obtained.
>
> Great advantage follows close cooperation between the plastic surgeon and the dental surgeon in the treatment of jaw injuries, also with the orthopedic, the neurologic, ophthalmologic and the general surgeon in their various fields. The psychologic handling of mutilated patients has been vastly improved.

65. Straith, C. L.: Elongation of Nasal Columella: A New Operative Technique, Plast. & Reconstruct. Surg. **1**:79 (July) 1946.

66. Weaver, D. F., and Bellinger, D. H.: Bifid Nose Associated with Midline Cleft of Upper Lip, Arch. Otolaryng. **44**:480 (Oct.) 1946.

67. Davis, J. S.: Plastic Surgery in World War I and in World War II, Ann. Surg. **123**:610 (April) 1946.

Straatsma[68] discusses the important contributions made to plastic surgery in World War II. He states:

> As always, when any comparatively new thing still has news value, it is the spectacular, whether true or false, that appeals to the imagination. Plastic surgery is no exception. Unless plastic surgeons make an effort—to put it plainly—to 'debunk' with facts some of the fallacious beliefs existing in the minds of many people, we may find ourselves placed upon the uncomfortable pedestal of being 'miracle-makers'; 'miracle-makers' who, unfortunately, cannot perform all of the miracles demanded of us. One of the most pernicious and persistent of such fallacies, which currently enjoys a great deal of credence, concerns just how 'perfect' a restorative

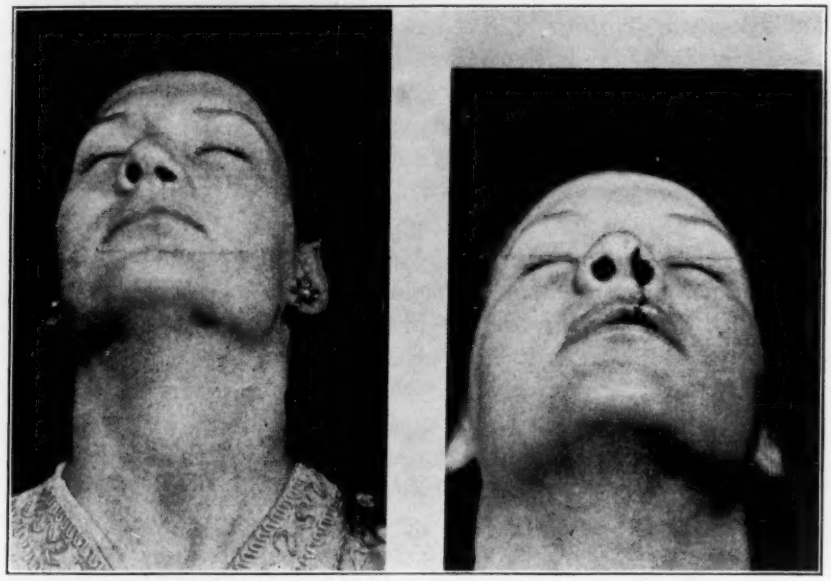

Fig. 12.—Straith's[65] correction of the typical flattened nostril and nasal tip seen with single cleft lip. At the right the scar of the lip has been excised, the columella elongated and the nostril lengthened by a crossed flap operation. Preserved cartilage was inserted to raise the left side of the nasal tip. (See figure 11, part 4, for insertion of preserved cartilage.)

> job even the ablest reconstructive surgeons can do . . . We can, it is true, make our disfigured service man better—better, perhaps, than he can reasonably expect to be. But we cannot erase all the marks of his catastrophe and we have no right to let a misinformed public hold out to him the hope that we can perform the impossible.

In a historical review of plastic surgery Alma Morani[69] emphasizes that there are no "short cuts" to satisfactory restorations in cosmetic surgery and that only living tissues can be substituted for living tissues.

68. Straatsma, C. R.: Plastic and Reconstructive Surgery, Mil. Surgeon **96**:255 (March) 1945.

69. Morani, A. D.: Evolution of Plastic Surgery, M. Woman's J. **52**:32 (April) 1945.

Reports of successful homologous skin grafts are rare, but these grafts will take and live for several weeks or months. Unfortunately, they later become absorbed by the host, which reacts to them as to other foreign substances. In isolated cases in which the victim of a burn cannot give up any of his own skin, it seems justifiable to use homologous grafts to tide him over the critical period. Later, when his condition improves, autogenous skin grafting may be undertaken with better results.

Americans are prone to look back to Europe as the original source of all new ideas in surgery. One is apt to give the native brilliant minds too little credit. This has been as true of the plastic as of other branches of surgery. In a very interesting and stimulating review of the development of plastic surgery in this country, Aufricht[70] presents the portraits of a number of early American surgeons and points out their contributions to this new field. It should be remembered while reading the article, he reminds one, that the classic works on free skin grafting by Reverdin, Ollier and Thiersch were not reported till 1869, 1872 and 1874, respectively.

Among the early American pioneers was John Peter Mettauer (1787-1875), who performed the first operation for cleft palate in the Western Hemisphere in 1827, using instruments designed by himself.

Jonathan Mason Warren (1811-1867) was the first to do the plastic operation on the hard palate (in 1843) now known as uranoplasty; he had a record of 24 cases of this kind, with failure in 1. As early as 1835 he reconstructed a nose by using the skin of the forehead according to the Indian method.

Thomas Dent Mütter (1811-1857) performed an operation in 1841 for burn scar contracture of the neck, employing a pedicle flap from the shoulder. Although the pedicle flap had been previously in use for repairing defects of the face, Mütter claimed priority in the application of this principle "for the relief of extensive cicatrices of the throat."

Observations on free skin grafting were made by Joseph Pancoast (1805-1882) as early as 1844, and Warren is accredited with "filling small breeches of surface" with "a portion of integument . . . entirely detached from the arm or thigh," even earlier. Pancoast mentioned the restoration of an ear after the lobe "had been torn completely off."

Frank H. Hamilton (1813-1886) published a treatise, in 1854, in which he described a technic by which a pedicle flap was successfully transferred from one leg to the other to cover a chronic ulcer; even the delaying procedure was used. Aufricht tells one that at this time it was considered that "an ulcer in 1830 will be an ulcer in 1860."

70. Aufricht, G.: Development of Plastic Surgery in United States, Plast. & Reconstruct. Surg. 1:3 (July) 1946.

During the Civil War Gurdon Buck (1807-1877) and David Prince (1816-1889) were two of the ablest representatives of plastic surgeons. In a manual on plastic surgery, published in 1876, the former urged the deformed and disfigured to seek surgical relief. The latter published a detailed and critical survey of the various methods of the plastic surgery then practiced. Aufricht quotes a piece of advice to specialists from the introduction to Prince's book:

> There is a misconception cherished in the medical profession that the practice of it is like the business of a shoemaker's shop in which each part of the work is done by a particular operative, the first man selecting the leather and the last one putting on the polish. The truth is far otherwise. While by natural selection or by accidental circumstances, special attention is given to a particular department, yet the best success in any one, requires a knowledge of all departments sufficient to see the relations of one to the other.

In an article which appeared on July 10, 1871, John T. Hodgen (1827-1882) reported grafting "bits of skin about half the size of canary seeds." The operation was done almost a year to the day after Reverdin made his report before the Societé Imperiale in Paris on Dec. 8, 1869. In this same article he mentioned, although somewhat vaguely, transplanting "sheets of epithelium" in 2 cases, thus preceding both Ollier and Thiersch.

More specifically regarding the development of corrective rhinoplasty, Aufricht points out that both John O. Roe, of Rochester, N. Y., and Robert F. Weir, of New York, performed rhinoplastic operations by the endonasal approach before Jacques Joseph, of Berlin, presented his classic paper in 1898. Roe's article entitled "The Deformity Termed 'Pug Nose' and Its Correction by a Simple Operation" appeared in 1887.

Roe also thoroughly appreciated the psychologic aspect of plastic surgery. He said:

> It will be a surprise to any physician who will take the trouble to investigate the subject, to find how many brilliant lives, how many noble personalities and how much valuable talent have been, so to speak, buried from human eyes, lost to the world and society by reason of the embarrassment and mortification caused by the conscious or, in some cases, the unconscious influence of some physical infirmity or unsightly blemish.

As early as 1898 George H. Monks, of Boston, understood the principles of all three of the commonest methods now in use for the correction of rhinophyma.

During World War I the importance of plastic surgery was finally recognized, and Drs. Vilray Blair, Robert Ivy and George Schaeffer were put in charge of hospitals especially designed for plastic surgery. John Staige Davis' important book, "Plastic Surgery," was published in 1919, and gradually during the twenties more and more hospitals established plastic surgery services. During the twenties and thirties the literature began to increase, and several societies of plastic surgeons

were formed. Aufricht considers that the most significant step toward the recognition of plastic surgery as a specialty was made when the American Board of Plastic Surgery was formed in June 1937, receiving the status of a major board in May 1941. It was largely through the efforts of Dr. Blair that this full recognition was finally accorded and that World War II did not find plastic surgeons of the United States unprepared.

According to Waldron,[71] it is apparent that, in conformity with the general progress and trends of the practice of general surgery and the specialties of surgery, certification of specialists in oral surgery will in the future be required for staff appointments in all important hospitals and for teaching positions in universities. Such certification is assuming greater importance in industrial surgery, and in compensation and insurance relationships, and may be anticipated in prospective prepayment programs of health insurance.

Palmer[72] urges that visual aids be used in the teaching of plastic surgery. These aids are motion pictures, photographs, lantern slides and models illustrating operative procedures. He illustrates a number of his models of nasal deformities and the methods of correcting such deformities. The immense advantage of this addition to the instructor's armamentarium is obvious.

Mowlem described the use of small pieces of cancellous bone laid side to side for bridging bony gaps. According to him, these bone chips may be used in the presence of mild infection. In a short article, Gordon,[73] of Toronto, discusses this work and corroborates Mowlem's findings with regard to mild infection. Gordon does not agree, however, with Mowlem regarding the latter's contention that the cancellous chips live, the former believing that the grafts die and are gradually absorbed and replaced.

According to Dick,[74] more than twenty years ago Albee made the statement that transplanted bone lives and grows in the same way as a transplanted twig grows in the tree into which it is grafted. Leriche and Policard and others held that transplants of bone always die and are replaced by cells originating in the host bone, and that such transplants form only a framework for the ingrowing bone. Phemister, Hey Groves, Campbell, Ghormley and Stuck showed that some of the bone

71. Waldron, C. W.: Graduate Training in Oral Surgery, J. Oral. Surg. **3**:265 (Oct.) 1945.

72. Palmer, A.: Training in Plastic Surgery—Visual Aids, Plast. & Reconstruct. Surg. **1**:113 (July) 1946.

73. Gordon, S.: Role of Cancellous Bone in Plastic Surgery, Surgery **20**:202 (Aug.) 1946.

74. Dick, I. L.: Iliac-Bone Transplantation: Preliminary Observations, J. Bone & Joint Surg. **28**:1 (Jan.) 1946.

cells, those near the periosteal or endosteal surfaces or in the haversian canals, live, grow and form new bone. The cells deep in the dense cortical bone die and are replaced. Imbert stated that this process is carried on in all parts but not simultaneously.

Stallcup[75] expresses the opinion that "pentothal sodium" has not been so extensively used as it should have been in view of the marked advantages which it possesses over other types of anesthetic agents. The three main advantages are safety with proper administration, ease of administration and the fact that the patients like it.

The knowledge that anesthesia induced with "pentothal sodium" has been held accountable for numerous deaths has caused many to hesitate to use this drug. Investigation shows that practically all the fatalities were due not to the drug but to faulty administration of it or to the physical condition of the patient plus the choice of anesthetic. Many of these fatalities have been due to respiratory failure occurring when the anesthetic was administered without the essential safety equipment and without physical examination.

Contraindications are hypotension, degenerative heart disease, Ludwig's angina (cellulitis of the floor of the mouth) and shock. Most authorities prefer ether for young children or infants.

According to Allen, Crossman and Lyons,[76] pain due to injury may be relieved by intravenous infusion of a solution of procaine hydrochloride within dosage limits determined by the onset of subjective symptoms. Central effects are produced by an increase of dose, resulting in a new form of anesthesia which promises to be ideal for obstetric operations and which may be of value in surgical procedures.

An analgesic effect is obtained almost immediately by intravenous infusion of 1 Gm. of procaine hydrochloride in 500 to 1,000 cc. of isotonic solution of sodium chloride in a period of one hour to one and one-half hours. Eradication of pain is largely the result of the peripheral action of procaine, which is concentrated in edematous parts because of the increased permeability of the capillaries of injured or inflamed tissue. The procedure may be extended to a wide range of painful conditions by increasing the quantities of infused fluid and drug, by lengthening the period of infusion and by using dextrose solution for patients in whom saline solution might conduce to harmful edema.

Danger to the patient is practically eliminated by keeping doses within the limits fixed by the onset of dizziness; patients with a rare idiosyncrasy to procaine are excluded by means of skin tests. Rapid and

75. Stallcup, L. B.: Pentothal Sodium Anesthesia Using Automatic Control Syringe Method, J. Oral Surg. **4**:1 (Jan.) 1946.

76. Allen, F. M.; Crossman, L. W., and Lyons, L. V.: Intravenous Procaine Analgesia, Anesth. & Analg. **25**:1 (Jan.-Feb.) 1946.

flexible control gives the intravenous method of administration a margin of safety over other methods. Infusion can be started slowly, increased cautiously and halted immediately at the first sign of danger. Circulating procaine is destroyed within ten minutes.

Hewson[77] reports a case in which a man suffered a severe reaction characterized by coma and convulsions following the administration of a small quantity of procaine hydrochloride. The author does not believe that the solution was given intravascularly or intrathecally. Allergy was not considered a factor in causing the reaction.

A review of the recent literature on keloids and a study of the results of radium treatment in 117 cases is presented by Strand.[78] The actual cause of keloid growth is still unknown, although individual, familial and racial predispositions are apparent. Tissue predisposition seems to be partly local and partly general and is somewhat limited in time. No tendency toward cancerous degeneration is shown by keloid growths, although in old scars with keloid nodes cancer of the epidermis has been observed to develop without any evidence that the two were casually connected. Multiple keloids may suggest multiple sarcomas, but the appearance of the keloids with their smooth, atrophic skin and characteristic branched spreading renders the diagnosis an easy matter.

Since the cause of keloids is unknown, preventive treatment cannot be given. With surgical removal there will practically always be a recurrence, and often the recurrent lesion will be larger than the original keloid. Radium treatment has proved to be more rapid and certain of producing a good result than roentgen treatment, and it lends itself to a more accurate and limited application, so that it has become the treatment of choice. Combined surgical and radiation therapy is rarely used, not only because the result is unsatisfactory but also because irradiation alone has given such good results. Where the keloid lies over a joint and impedes its function, a plastic operation followed by irradiation is indicated.

(Comment: Plastic surgeons in general feel that the greatest improvement in severe facial keloid scars is obtained by surgical removal of the keloids followed by early postoperative irradiation to minimize new keloid formation.)

Hance and her colleagues in 1944 and Byars in 1945 (see previous reviews) called attention to permanent pigment injections for color matching of skin grafts and flaps and for other deformities of the face.

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77. Hewson, G. F.: Procaine Toxicity with Report of Near Fatal Case, Mil. Surgeon **97**:489 (Dec.) 1945.

78. Strand, S.: On Keloids and Their Treatment, Acta radiol. **26**:397, 1945.

Brown, Cannon and McDowell[79] believe that capillary hemangiomas, or "port wine stains," can be improved by tattooing with white pigment. It is suggested that the results may prove superior to those obtained with any other form of treatment now in use. The authors explain that, although the multiple stab wounds of the tattooing needles may be responsible for thrombosis of some capillaries, it is the pigment itself that relieves the intensity of the red in hemangiomas.

In the opinion of Austin,[80] the Schüller-Christian syndrome of generalized xanthomatosis is of dental interest because of the frequent involvement of the maxilla and the mandible. Attention has been called by many writers to the triad of associated symptoms: exophthalmos, diabetes and defects of the membranous bones. Kennedy, in 1938, reported 8 cases observed at the Mayo Clinic. All the patients were children. In 5 of these, the mandible and the maxilla were involved, and loss of teeth had occurred. The disease affected the structures of the reticuloendothelial system, and lesions were found in all parts of the body, but not all of the three symptoms were present in every case. However, in Kennedy's cases defects of the skull were found in almost every instance. Radium and the roentgen rays seem to be the most valuable therapeutic agents.

Slaughter[81] directs attention to the admittedly poor results being obtained throughout the country in the treatment of intraoral cancer and offers an explanation. He believes that the lesions arise from multicentric foci of epithelial change and spread by "progressive lateral cancerization." Lateral cancerization, he explains, may occur either through multicentric foci of independent epithelial change or through a carcinogenic effect of cancer cells on benign epithelium. This concept is not new; it is one that was discarded by the older pathologists.

Slaughter found that 14 of 80 patients, or 18 per cent, had multiple epidermoid carcinomas so situated that one lesion could not have originated by direct extension from another. Several photomicrographs are shown to illustrate the distinct origin. He concludes that "many so-called local recurrences may in reality be new foci of cancer arising in the peripheral field of a previously treated tumor."

Sargent[82] reports a study of massive recurrent hemorrhage caused by erosion of a blood vessel beneath the surface, with the source not

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79. Brown, J. B.; Cannon, B., and McDowell, A.: Permanent Pigment Injection of Capillary Hemangiomata, Plast. & Reconstruct. Surg. **1**:106 (July) 1946.

80. Austin, L. T.: Xanthomatosis (Schüller-Christian's Disease): Report of Dental Findings in One Case, J. Oral Surg. **4**:209 (July) 1946.

81. Slaughter, D. P.: Multicentric Origin of Intraoral Carcinoma, Surgery **20**:133 (July) 1946.

82. Sargent, F. B.: Recurrent Severe Hemorrhage from Nose and Pharynx, Ann. Otol., Rhin. & Laryng. **54**:495 (Sept.) 1945.

immediately evident. The internal carotid artery is the vessel usually involved, but cases of involvement of the external carotid, the superior laryngeal and the ascending pharyngeal artery have been reported. Ligature of the common carotid artery has been described as the treatment of choice. It is emphasized that whereas ligature of the external carotid artery presents no danger, ligature of the internal or of the common carotid artery may lead to loss of consciousness or to hemiplegia. The mortality rate is 15 per cent. In cases of recurrent massive hemorrhage without ligation, the death rate is 60 to 80 per cent.

(Comment: One of us (Dr. Peer) has observed 2 cases in which severe postnasal hemorrhage occurred on the sixth and eighth days following rhinoplasty. In each of these cases the inferior turbinates had been reduced in size and a submucous resection performed. The precise source of the bleeding, which was arterial and unilateral, could not be located, nor could it be controlled by large postnasal packs. With ligation of the external carotid artery, the bleeding stopped, and the patients survived. Ligation of the external carotid artery was undoubtedly a life-saving procedure for both these patients. The usual fault is that the surgeon wastes much valuable time in useless attempts to stop the bleeding before he resorts to ligation.)

In discussing total avulsion of the scalp, Straith and McEvitt[83] emphasize that simple replacement and suture are without hope of success. The scalp being a complex organ with a definite arterial blood supply, death is certain when this supply is destroyed. All previous experience with free grafting has demonstrated that no structure of such size and complexity can receive nourishment adequate for life from underlying tissue fluids. The authors report a case of complete avulsion of the scalp in which the exposed raw area was covered by a thick dermatome skin graft. This graft was made to adhere to the skull by fibrin fixation.

For the wound seen immediately, Straith and McEvitt[83] suggest a method of splitting the scalp and using the outer layers as a free graft, which may in the future provide victims of total avulsion with a hair-bearing coverage for the skull.

In an article entitled "The Closure of Skull Defects," Jaeger[84] states that cranioplasty, like surgical treatment of the brain, has lagged far behind the reconstruction of other parts of the head. The problems of shock, anesthesia and sepsis are with the surgeon always, but they are

83. Straith, C. L., and McEvitt, W. G.: Total Avulsion of Scalp: Review of Problem with Presentation of Case of Skin Graft in Which Thrombin Plasma Fixation Was Used, Occup. Med. **1**:451 (May) 1946.

84. Jaeger, R.: Closure of Skull Defects, Plast. & Reconstruct. Surg. **1**:69 (July) 1946.

sufficiently well understood now to assure the patient of a safe and painless procedure, even though the brain itself may be attached to a scar in the scalp.

The causes of defects of the cranium are trauma, neoplasm, infection and congenital malformation; trauma is by far the most common. Generally speaking, all defects of the skull should be repaired if they the unsightly, if they are large enough to pulsate, or if the patient worries about them.

Autogenous bone with its periosteum, stainless steel and tantalum are the materials best suited to fill large defects, while fresh living autogenous cartilage is more easily and perfectly shaped for locations requiring small pieces.

Jaeger considers fresh bone with its periosteum from the patient's tibia to be the most satisfactory material with which to close a skull defect, provided the opening is not too large or complicated in shape. If the defect is not filled immediately after the injury or in the first subsequent week or two, it is better to wait at least four months before carrying out the repair. If scars are present which are adherent to the dura and the brain with a very thin layer of skin, it is preferable to do a preliminary resection of skin and scar several months prior to the cranioplasty. A technic for taking the tibial grafts is described.

For rapid closing of a torn scalp, as under war conditions, or in the event of huge defects, tantalum or stainless steel plates are recommended. Prior to the operation a plaster of paris form of the defect should be made. Two technics for this purpose are briefly described.

Abstracts From Current Literature

INFLUENCE OF CONSTITUTIONAL FACTORS IN OTOLOGICAL CONDITIONS. BERNARD J. MCMAHON, Ann. Otol. Rhin. & Laryng. **56**:298 (June) 1947.

Hypothyroidism is often a cause of lowered resistance to infection and should be recognized as a contributing factor in aural infections. It may produce myxedema, which may involve the eustachian tube and even the entire mucosa of the middle ear, causing conductive deafness. The perception factor is also important, but whether this exists because of the innate mental dulness of the patient, hydrops of the cochlea or the auditory nerve or actual albuminoid effusion affecting the central nuclei is conjectural. Allergy may cause deafness, tinnitus, vertigo and serous otitis media. Deficiency of vitamins A and B may contribute to general lowering of resistance and thus predispose to infections of the middle ear. Disturbances of function of the pituitary and parathyroid glands and deficiency of vitamin D may give rise to faulty metabolism and distribution of calcium and phosphorus leading to abnormal bone changes in the otic capsule.

M. V. MILLER, Philadelphia.

SURGICAL TREATMENT OF DEAFNESS. M. AUBRY, Ann. d'oto-laryng. **64**:5 (Jan.-Feb.) 1947.

Aubry presents a comprehensive review of the history and progressive steps of the surgical relief of deafness. Historically he designates these steps as follows:

Scientific phase: Bárány, thence Holmgren, demonstrated the feasibility of improving audition by opening the semicircular canal. Unfortunately, the gain proved to be transitory.

Surgical phase: Sourdille demonstrated the possibility of maintaining this gain by the use of the tympanomeatal plastic flap. His procedure was intricate, necessitating several operative steps.

Practical phase: Lempert simplified the technic of Sourdille, and with the advent of penicillin therapy it was possible to carry out the surgical procedure in one step. A great stimulation ensued in this field of surgery.

The author describes his modification of the operations of Sourdille and Lempert, as follows:

1. The endaural approach is used with only the AB and AC incision.

2. The superior wall of the canal is freed to and including the tympanic ring.

3. A simple atticotomy is performed without opening into the antrum or the aditus. The bony trephination thus consists only in enlarging the bony canal upward and thus is quite limited.

4. On exposure of the ossicles, the incus and the head of the malleus are removed as advocated by Lempert.

5. Fenestration is performed with a polishing burr, the Shambaugh technic being followed.

6. A flap is then shaped and put in place so as to cover the entire internal wall of the attic and also seal the attic orifice of the aditus. The cells of the mastoid process are thus excluded from the operative cavity.

The advantage of this procedure is that the trephining of bone is reduced to the minimum and thus the postoperative suppuration is reduced as the mastoid process is not really involved in the healing process. Post-traumatic labyrinthitis is greatly reduced, as well as the operative time and the postoperative dressings.

VIOLE, Beverly Hills, Calif.

SOME REMARKS ON THE FENESTRATION OPERATION AND WHAT LEADS TO THE RESULTS. J. VENKER, Amsterdam, N. V. Noord-Hollandsche Uitgevers Maatschappij, 1947.

This article concerning various phases of otosclerosis and fenestration of the labyrinth has much in it of interest to the otologist. The author starts off with a review of some of the literature, detailing the evolution of the surgical treatment of otosclerosis, mentioning the early experimenters in this field and carrying the development through the efforts of Holmgren, Sourdille, Lempert and others who have aided in the formation of the modern surgical technic.

He describes the instruments he uses for the operation. In general they are much the same as those used in the United States with the addition of a suction-flushing apparatus which can be used in one hand. His indications for the operation are essentially the same as those generally accepted in this country, except that he believes a reduction of bone conduction up to 40 decibels for the frequencies of 1024 and 2048 cycles per second is acceptable. He advocates the withdrawing of 300 to 500 cc. of blood a few days before operation to shorten the clotting and bleeding time. For anesthesia a combination of preoperative morphine and scopolamine sedation and local injection of the anesthetic supplemented with inhalation of ether is used.

The operative technic is gone into in some detail. Venker prefers the post-auricular incision, but otherwise his technic differs little from the one described by Lempert. He uses a cartilaginous stopple in the completed fenestra. Throughout his paper Venker freely quotes the opinions and cites the methods of others everywhere who have published articles on this subject.

Details of 12 cases in which he operated are discussed, out of a total of 25 in which he had performed the operation described. In 8 of the 12 cases the operation was considered successful after a postoperative period of two to four months. Postoperative complications are discussed, emphasis being placed on the development of temporary facial paralysis and serous labyrinthitis.

The author goes into considerable detail in discussing the observation that the hearing of the ear not operated on is frequently improved as well as that of the ear operated on. He quotes incidences, experiments and opinions of himself and others tending to substantiate the idea that increased supply of blood in the inner ear mechanism enhances the improvement of hearing. From his extensive arguments regarding this question he concludes:

1. That otosclerosis is based on a defective vasomotor reflex of the entire organ of hearing.

2. That this vasomotor reflex may sometimes be restored wholly or partly and that the deafness is thereby rendered stationary.

3. There is not, therefore, a permanent defect in the vasomotor reflex as was concluded by Gray.

In general he believes that the good results of the operation depend not only on the mobilization of the perilymph but also, for a large part, on the better supply of blood.

Further observations are made on the factors that influence the results of the operation, and several conclusions are reached as follows:

1. The greatest successes are attained in young persons.
2. Bone conduction is not a decisive criterion of the state of the acoustic nerve.
3. In successful cases bone conduction is improved after the operation.
4. Presumably the operation arrests the otosclerotic process.

In conclusion, the author describes the blood supply system of the ear mechanism and the vegetative nervous system as it may effect the organ of hearing, and, on the basis of his theory that vasomotor changes play an important part in the causation of otosclerosis and the functioning of the hearing mechanism, he discusses the possibility of producing prolonged hyperemia of the organ of hearing and resultant improvement of hearing by performing bilateral periarterial sympathectomy of the carotid arteries.

CAMPBELL, Philadelphia.

Larynx

THE EVOLUTION OF INTUBATION. JOSEPH O'DWYER, M.D., Arch. Pediat. **13**:401 (June) 1896. Reprinted in Arch. Pediat. **63**:403 (Aug.) 1946.

The author's discussion of his experiments carried on from the time he first thought of intubation to the completion of a successful method are most interesting and make delightful reading. Although he was faced with seemingly insurmountable obstacles, the death of almost all his early patients and the objections of his colleagues, his persistence and tenacity eventually won out, and the practice of intubation became an accepted procedure.

DAVIS, Denver, AM. J. DIS. CHILD.

SURGICAL TREATMENT OF THE BASE OF THE TONGUE BY TRANSLARYNGEAL APPROACH. GEORGES PORTMANN, Rev. de laryng. **67**:565 (Oct.) 1946.

The author's new technic of performing total laryngectomy in three stages gives a good view into the hypopharynx and the oropharynx from below up to the foramen caecum. The glossoepiglottic and glossotonsillary fossae are well visualized. After the larynx has been removed, the surgeon makes a resection of the body of the hyoid bone; traction is made outward and down on the base of the tongue with a Museux forceps, and resection of the invaded part is performed with scalpel or diathermic knife. The correspondent remaining parts of the tongue are sutured together with heavy silk; then pharyngostomy is performed. This procedure of laryngectomy with resection of the base of the tongue is indicated as a rule in the tumor of the epiglottis which has extended to the base of the tongue.

Another technic is described by the author for the tumor that is primarily localized to the base of the tongue, whether it has or has not extended to the tonsillar regions:

1. Low tracheotomy is performed as a preparatory stage.

2. Pharyngolaryngectomy is then carried out as follows: (*a*) An incision is made in the form of an inverted T. Its curved, concave, inferiorly horizontal branch is 1 cm. above the hyoid bone; its vertical branch reaches the upper border of the cricoid cartilage.

(*b*) The infrahyoid muscles are sectioned close to the hyoid bone; then the larynx is dissected laterally (over the thyroid cartilage) from the surrounding tissues.

(*c*) Oblique section of the thyroid cartilage is started at the middle of the anterior angle and directed backward. It is performed with Liston scissors, and it opens the laryngeal vestibule above the vocal cords, reaching the posterior part of the aryepiglottic fold; the anterior part of the larynx thus sectioned is caught with Museux forceps.

(*d*) Section of the preepiglottic tissues is carried out, passing between the epiglottis and the hyoid bone; the epiglottis is removed with the upper part of the thyroid cartilage.

(*e*) Resection of the body of the hyoid bone, previously dissected from its muscular attachments, follows.

(*f*) The base of the tongue is caught with Museux forceps through the opening of the hyoid region, and a resection of the invaded lingual tissue is made, with suture of the remaining parts.

(*g*) Pharyngostomy is performed by suturing the skin to the mucosa of the laryngeal vestibule, piriform sinus and base of the tongue.

(*h*) A feeding tube is inserted through the nose; then follows tight packing of the pharynx with Miculicz' dressing. The latter is held in place by the vocal cords and closes completely the lower respiratory passages.

Later a plastic closure of the pharyngostomy opening is made.

The foregoing technic allows easy insertion of radium needles if necessary. The anterior lingual stump keeps good motility after the operation, and the patient can swallow and speak without difficulty.

Two cases are reported, both of total laryngectomy with resection of the base of the tongue for extralaryngeal carcinoma invading the epiglottis and the tongue.

HERSON, Chicago.

Nose

THE CONTROL OF MUSCLE SPASM AND ARTHRITIC PAIN THROUGH SYMPATHETIC BLOCK AT THE NASAL GANGLION AND THE USE OF THE ADENYLIC NUCLEOTIDE. SIMON L. RUSKIN, Am. J. Digest. Dis. **13**:311 (Oct.) 1946.

The dramatic relief of painful muscle spasm and arthritic pain through anesthetization of the sympathetic nerve at the nasal ganglion (sphenopalatine ganglion, Meckel's ganglion) heralds a new and effective approach to the treatment of arthritis. It demonstrates the intimate relationship between muscle metabolism and spastic states with impaired peripheral circulation and nutrition of joints. Edema of the small and large joints rapidly disappeared after the relief of muscle spasm, and mobility of the joints could be obtained practically within a few minutes. A study of the physiology of muscle contraction revealed that a muscle in the contracted or spastic state has spent its energy and that relaxation is the phase that requires energy—similar to that of a rubber band which requires a pull for elongation while the contracted state represents expenditure of energy. For the restoration of energy for relaxation the adenylic nucleotide, as the iron salt "ironyl," is employed. Since all muscle energy is obtained through the breakdown of the system adenylic acid-adenosine diphosphate-adeno triphosphate, the immediate supply of the adenylic nucleotide ("ironyl") served as a "booster" for muscle relaxation. The treatment of the sympathetic nerve apparently musters reserve energy to start the relaxation, while the adenylic nucleotide supplies the additional fuel for its continuation.

Sixty-eight cases of striking relief are cited.

AUTHOR'S ABSTRACT.

THE USE OF THROMBIN IN NASAL SURGERY. SAMUEL L. FOX, Ann. Otol., Rhin. & Laryng. **56**:127 (March) 1947.

In submucous resections all free blood and clots are removed by suction from between the flaps, and thrombin is sprayed into the area, after which the flaps are held tightly together for three to four minutes. A drop is placed over the incision and over any tears of the mucosa. If any surgical procedure has been done on the turbinates or intranasally on the sinuses, these areas are cleansed of blood and clots and thrombin applied there. The author packs the nose for fifteen to twenty-four hours.

In rhinoplasty, after the operation is completed, the thrombin solution is sprayed beneath the skin of the dorsum, and firm pressure is applied over the nose with gauze for several minutes. It is essential to place the skin carefully and exactly where desired, as after a few minutes it becomes so adherent that it requires a knife or a periosteal elevator to break the adhesions.

M. V. MILLER, Philadelphia.

ETHMOIDITIS IN THE ADULT. RAUL PIETRA, An. de oto-rhino-laring. **17**:46, 1947.

Pietra discusses ethmoiditis under several headings. First he considers its causes, anatomic and clinical forms, complications and treatment; second, chronic ethmoiditis—general considerations, causes, clinical picture, radiologic studies, differential diagnosis, complications and finally medical treatment. This is a clear-cut presentation of the entire subject in great detail. The author stresses many salient factors, such as the role of allergy and the influence of avitaminosis, endocrine disturbance and infection. Under treatment, emphasis is placed on infection and allergy. Both with the acute and with the chronic forms of ethmoiditis there is a marked tendency toward conservatism in all treatment. Surgical intervention is recommended only as a means of last resort or in the presence of impending complications.

PERSKY, Philadelphia.

Miscellaneous

SPEECH THERAPY FOR CHILDREN WITH CEREBRAL PALSY. M. A. PERLSTEIN and MARIE SHERE, Am. J. Dis. Child. **72**:380 (Oct.) 1946.

The authors deprecate the fact that these children are neglected, since from 50 to 75 per cent can be benefited by speech training. The nature of the motor difficulty must first be adequately established through neurologic, orthopedic, pediatric, visual and speech tests. Athetosis and spasticity must be differentiated. Relaxation of the entire body musculature is the first step. Quiet rhythmic music may help to do this. A set of exercises is described, and other exercises may be given "according to Jacobson's principles." Since breathing difficulties are common, especially "reversed breathing," correct use of the respiratory cycle is essential. The ultimate purpose is to give the child a sense of personal worth and a place in society. There is a definite and mutually beneficial relationship between speech therapy and school work which can be obtained through lifting the ego to a point where the child feels that he is important in spite of his disability, thereby establishing a feeling of confidence. Ophthalmologists and otolaryngologists with other specialists can help build a foundation both for the work of the speech teacher and for the personality of the child. Hitherto, a negative attitude on the part of the physician has delayed the consummation of this cooperative enterprise.

VOORHEES, New York.

HEMOPHILUS INFLUENZA MENINGITIS TREATED WITH STREPTOMYCIN. HATTIE E. ALEXANDER, GRACE LEIDY, GEOFFREY RAKE and RICHARD DONOVICK, J. A. M. A. **132**:434 (Oct. 26) 1946.

Twenty-five patients received streptomycin therapy. The dosage of the drug was 20,000 units per pound (0.5 Kg.) of body weight per twenty-four hours intramuscularly and 25,000 to 50,000 units daily intrathecally. Two patients showed a reaction (coma) to an injection of the drug intrathecally, probably because of the presence of impurities. One child had damage of the eighth nerve resulting in deafness.

Twelve of the patients had mild or moderately severe forms of the disease. All had received sulfadiazine therapy and had been ill less than eight days. All recovered with streptomycin alone. Five patients had a severer form of the disease or had been ill longer. These patients did not respond to streptomycin alone. One recovered, and lived after being given sulfadiazine and rabbit serum therapy. Four patients who had not responded well to sulfadiazine and serum therapy were given streptomycin. Two recovered, and 1 lived. Four children were treated with all three therapeutic agents, and all recovered.

The therapeutic results suggest that it is the severity of infection, and therefor the size of the bacterial invasion, which determines whether the strain of organisms from a given patient will become resistant to streptomycin. Initial use of all three agents would probably reduce therapeutic failure to a minimum in cases of severe infection.

BAIRD, Wauwatosa, Wis., AM. J. DIS. CHILD.

VIRAL INFECTIONS OF THE RESPIRATORY TRACT: THEIR TREATMENT AND PREVENTION HOBART A. REIMANN, J. A. M. A. **132**:487 (Nov. 2) 1946.

The common infections of the respiratory tract of viral, or presumably viral, origin can be tentatively grouped on epidemiologic, clinical and etiologic grounds as the common cold, pharyngitis (tonsillitis, sore throat), grip (febrile catarrh), viroid (including virus) pneumonia and influenza. The causes of several are known, and those of the rest await discovery before final classification is possible. Many preventive and therapeutic measures in common use are in need of revision or rejection. Except for influenza, there are no specific preventive procedures, and no specific therapy exists for any infection of the group. Management should be suited to the needs of the patient in order to relieve discomfort, to prevent complications without impeding the natural process of recovery and to minimize the spreading of infection to others.

FROM THE AUTHOR'S SUMMARY, AM. J. DIS. CHILD.

MENINGITIS DUE TO ESCHERICHIA COLI: STREPTOMYCIN THERAPY. WILLIAM P. SHIELDS, J. A. M. A. **132**:514 (Nov. 2) 1946.

Meningitis due to Escherichia coli communior infection of a 5 week old child is reported. Sulfadiazine and penicillin therapy was instituted on the fifth day of apparent illness. Streptomycin therapy was begun two days later and continued for ten days. Administration was intramuscular and intracisternal. The child received 2,630,000 units intramuscularly and 300,000 units intrathecally, without apparent untoward reaction. Recovery was complete.

BAIRD, Wauwatosa, Wis., AM. J. DIS. CHILD.

SPEECH RECEPTION IN RELATION TO PATTERN OF PURE TONE LOSS. RAYMOND CARHART, J. Speech Disorders **11**:97, 1946.

Five groups of subjects were selected for this study, who were tested at the Deshon General Hospital Aural Rehabilitation Unit between November 1944 and May 1945. Group 1 comprised 50 whose audiograms showed flat thresholds of hearing, characterized by equal loss in all frequencies; group 2, 50 having progressively greater impairment for higher frequencies at a slope of 5 to 10 decibels per octave; group 3, 32 having progressively greater impairment for higher frequencies at a slope of 15 to 20 decibels per octave; group 4, 50 whose audiograms showed notched thresholds characterized by flat or gradual high tone loss to 2048 per second and a sharp notch of increased loss beyond 2048; group 5, 50 having typical audiograms, characterized by irregularities and curve shapes which precluded inclusion in any major category.

The subjects were selected because they had audiograms presenting the best examples of the types found in the examination of the hundreds going through at the time. One hundred subjects were also selected completely at random, and the patients were also studied as a general group. The seven groups described were compared on the basis of three criteria of auditory acuity: speech reception threshold, "better ear" average for 512 to 2048 cycles per second, American Medical Association percentage of loss measured. The data were treated by correlation methods and by analysis of variance. The following results and conclusions are recorded: 1. A high correlation between speech reception and each of the two other criteria was found for all groups except those with high tone loss progressing at a slope of 15 to 20 decibels per octave (group 3). 2. Acuity for frequencies at the extremes of the audiometric test range is minimally related to speech reception threshold. Patients whose audiograms show notches beyond 2048 cannot be differentiated on any important point from the group with flat losses. 3. Group distributions for difference scores between speech reception threshold and pure tone average were not significantly differentiative except for those with marked high tone loss (group 3). The latter showed a trend toward better score on speech reception than on pure tone average. The implication is that acuity between 512 and 1024 is more closely related to speech reception than is acuity between 1024 and 2048 cycles per second. 4. The subjects of group 3 are differentiated by sufficient factors so that this group may be accepted as constituting a special clinical category. 5. The American Medical Association percentage method gives less numerical parallelism with the speech measure than does the 512 to 2048 average. This fact plus the extra labor involved makes the pure tone average a more useful clinical tool except for special purposes. No statistical reason emerged from this study for favoring a percentage score over a simple "better ear" average.

PALMER, Wichita, Kan.

HYPNOSIS IN A SYSTEM OF THERAPY FOR STUTTERERS. WILBUR E. MOORE, J. Speech Disorders **11**:117, 1946.

Forty stutterers who were under treatment at the speech clinic of the Central Michigan College of Education were subjected to hypnosis. Thirty-one were so responsive that some type or degree of somnambulism could be induced. Thirty-five reported good relaxation. In the case of 5 subjects certain data which in the writer's opinion could not have been recalled without the aid of hypnosis proved to be of great use in pointing out to the stutterers a possible basis of their signal reactions to speech and to human beings. Three cases in which treatment of stuttering was successful are reported; in one the patient had enjoyed two years

of essential freedom from stuttering. Hypnosis consisted of direct therapeutic work in which it was suggested to the patient that he could talk in an easy, relaxed manner, undisturbed by pauses. All patients received other clinical help.

PALMER, Wichita, Kan.

INFANT SPEECH; VOWEL AND CONSONANT FREQUENCY. ORVIS IRWIN and HAN PIAO CHEN, J. Speech Disorders **11**:123, 1946.

Ninety-five infants ranging in age from newborn to 2.5 years were studied in deriving equations for vowel and consonant frequencies during these years. Two equations are needed to express vowel frequency development. The first, which includes the first two years of life, is

$$V_t = 0.69A + 51.8$$

The second equation is

$$V_t = 11.78A^{2.5}$$

The equation derived from the means of consonant frequency is

$$C_t = 12.5e^{0.124A}$$

This is an exponential curve. Throughout the first thirty months of life the frequency of vowel sounds exceeds that of consonant sounds. At the first bimonthly period vowel sounds occur about five times more frequently than consonant sounds, and not until the last two month period are their frequencies approximately the same. The processes of development of vowel and consonant frequency are radically different. It is reasonable to assume that these three equations express the laws according to which phonemic frequencies develop during infancy.

PALMER, Wichita, Kan.

THE TYPE-TOKEN RATIO APPLIED TO INFANT SOUNDS. ORVIS C. IRWIN and HAN PIAO CHEN, J. Speech Disorders **11**:126, 1946.

The type-token ratios of infants under 1 year of age are presented in relation to the size of the token and to the age of the infant. The type-token ratio is the relation between the number of different categories of phonemes to the total number of speech sounds in a given sample. The data analyzed were based on speech sound samples obtained from infants 12 months old and under. They were further subdivided into six age levels with a two month period as a level. The number of infants for each age level from the younger to the older group were 62, 80, 75, 64 and 62, respectively. All the infants appeared to be normal. Type-token ratios of infants under 1 year of age were taken, and a three-dimensional graph was presented showing the interrelationships of the three variables: type-token ratio, age, and size of token. A description of the construction of the graph and directions for its use are outlined. In order to test their validity, these readings were compared with corresponding values calculated from analysis. The differences between analysis and graph values were negligible.

PALMER, Wichita, Kan.

METROPOLITAN SPEECH CORRECTION. BERNEICE RUTHERFORD, LILLIAN READ and MYFANWY CHAPMAN, J. Speech Disorders **11**:131, 1946.

Forty-three metropolitan school systems of over 100,000 population indicated on a questionnaire that the lower the ratio of the school population to the number of speech clinicians, the more adequate the speech correction service. The itinerant

teacher plan and semiweekly service in elementary schools were typical and did not seem to be related to adequacy of service. As a general rule, there was inadequacy of service. A combined clinical survey and referral by classroom teachers and a combination of referrals from many sources were typical patterns. Speech correction service was given to about 2 per cent of the elementary population. Speech clinicians in most cities were required to have either specialized training or a degree in speech pathology. The questionnaire method of study allows for variation of interpretation.

PALMER, Wichita, Kan.

Is IS NOT THE VERB FOR APHASIA. JEANETTE O. ANDERSON, J. Speech Disorders **11**:135, 1946.

Some general notes are published concerning a complete study of 18 cases of aphasia. The following general inferences are made: 1. Any series of tests can serve only as a guide in testing aphasia; procedures must be adapted to each patient in terms of his abilities and disabilities after discriminating analyses of errors and successes. 2. Ordinary tests of linguistic activities cannot be used successfully in the examination of aphasic patients for the purpose of estimating the capacity for being reeducated. 3. Skills depending on the relearning or the rerouting of motor patterns seem to be regained more easily than skills dependent on sensory patterns. 4. Motivation is strongest and progress most sure when therapeutic technics are adapted to the patient's greatest interests and to his usual activities. 5. The patient will usually possess one ability relatively stronger than his others; if this can be used as a leading device in arranging therapeutic methods, response to other stimuli seem to be strengthened. 6. The most important single cause of success or failure in the linguistic retraining of aphasic patients is personal potential or the "x-factor."

PALMER, Wichita, Kan.

LINGUISTIC PROBLEMS OF BRAIN-INJURED SERVICE-MEN. MARY HUBER, J. Speech Disorders **11**:143, 1946.

Patients whose brains have been injured and who are in consequence linguistically handicapped appear most often in the neurologic wards of the various hospitals. The problem is usually called aphasia. Numerous patients of this type are now receiving language reeducation in the Army General Hospital Program. In work at the Halloran General Hospital it was the custom to outline for each patient a variety of activities aside from the usual speech clinic program to facilitate language development, such as attending the news center daily, seeing all the movies, plays and entertainment programs, and participating in conversations. In such cases the first and most essential technic is to improve the auditory comprehension of words. Personality traits strongly influence the patient's attitude toward speech reeducation. Many patients lack the power to initiate an activity themselves. Most of the functions of the central nervous system are slowed. Any function, including linguistic activity, is likely to lack order, rhythm and coordination. Attention lags and comprehension becomes blurred when the discussion is complicated. Emotional outbursts and frequent expressions of profanity usually indicate that the situation has become too difficult. Psychotic manifestations, on the other hand, are not common. The term "hysterical aphasia" is a misnomer. The symptoms of aphasia are too subtle and too complicated to be simulated by anyone who has not had first hand experience of the affliction. The most intelli-

gent and well educated patients are often the worst subjects for reeducation, because they remember too well their former abilities. Most patients require a certain amount of individual assistance, but group activity also helps. Some patients are capable of spending from three to six hours a day on reeducation. A decision often has to be made whether to permit a shift of handedness or to trust that the preferred hand will recover. Language improvement is usually slow, and the smallest gain must receive encouragement from all.

PALMER, Wichita, Kan.

PERENNIAL VASOMOTOR RHINITIS: A MODERN APPROACH TO DIAGNOSIS AND TREATMENT. F. HOWARD WESTCOTT, New York State J. Med. **47**:57 (Jan. 1) 1947.

Westcott says that otolaryngologists send most patients with perennial vasomotor rhinitis to the allergist because they can do little for them by local treatment. The condition may be a "symptom complex" to the doctor, but it is a real entity to the patient. Diagnosis is based partly at least on symptoms which do not differ greatly from those of rhinitis and hay fever. It is important for the otolaryngologist to make sure that no latent infection of the nasal or sinal mucous membranes is at hand and that all obstructions are cleared. He should not depend on eosinophilia too strongly, since in 44 cases a smear revealed only 45 per cent eosinophils! More important is the number of leukocytes. A family history may suggest allergy, or the patient's own experience of urticaria, migraine, eczema, asthma and other manifestations of allergy may give a clue. An average plan of treatment is about as follows: 1. Avoid substances that cause cutaneous reactions—inhalants, certain foods, animal danders, cosmetics—to name a few types. 2. Avoid sudden changes in environment, thermal irregularities and drafts. 3. Use a diet of foods known to be nonallergenic. 4. Avoid tobacco smoke, house dust, certain pillows, pets and cosmetics. 5. Desensitize the patient by using agents which produce similar symptoms. 6. Administer high doses of vitamin A (50,000 to 100,000 units daily in all bacterial cases) and ascorbic acid (100 to 500 mg. daily in cases in which inhalants are concerned). 7. Use contrast baths and histamine desensitization for thermal and physical allergies. 8. Apply nonspecific measures in all cases in which specific therapy cannot be carried out. Temporary use may be made of antiallergic drugs for relief of symptoms.

VOORHEES, New York.

MENINGITIS TREATED WITH PENICILLIN AND STREPTOMYCIN. ALAIS REGULES and PEDRO HOUNIE, An. de. oto-rino-laryng. d. Uruguay **17**:18, 1947.

The authors present a case of meningitis due to Bacillus pyocyaneus (Pseudomonas aeruginosa) apparently following an infection of the upper respiratory tract. Although mastoidectomy was performed, no frank pathologic condition was noted. Penicillin and sulfadiazine were administered, and for a few days there was remission of the symptoms, but these recurred, and streptomycin was added. There was immediate recession of the symptoms, and the patient made an uneventful recovery. He received a total of 18,600,000 units of penicillin, 7 Gm. of streptomycin and 1,125 Gm. (187½ grains) of sulfadiazine. Examination of the spinal fluid showed a complete return to normal—from 1,800 to 30 cells per cubic centimeter—at the last examination.

In conclusion the authors state that while penicillin and sulfadiazine alone may control certain infections, it may be necessary to supplement them with streptomycin to effect a complete cure.

PERSKY, Philadelphia.

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